# 2023-2024 BESST Research Project Descriptions

### 1. Title: Field and Laboratory Research Assistant

**Mentor: Terry Loecke**

**Description:** Nature based climate change mitigation approaches are in high demand. One potential approach is to store organic matter in deep soils, thus removing carbon dioxide from the atmosphere, but little is known about the persistence of recently added organic matter to deep soils. This project will investigate if organic matter (e.g., plant roots) interacts with deep soils differently than with surface soils. In pursuing this project the student research assistant will learn to operate several analytical chemistry instruments, such as a gas chromatograph, a ion chromatograph, and a spectrophotometer, as well as soil sampling techniques, data entry, and data processing.

**Potential Student Tasks:** The student will work with a team to collect soils from the field and prepare the soil for analysis and experimentation. Field sampling may include travel to nearby research sites and operation of soil sampling equipment. Preparing soil samples for analyses entails sieving, weighing, drying, grinding, and packaging soils in sample containers. Experiments on the soils will require the use of gas chromatography techniques and incubations. Characterization of the organic matter will involve several analytical approaches in the lab. The student will gain expertise in at least two of the approaches commonly used in the lab.

**Student Qualification Recommendations:** The student is required to have a willingness to learn about the connections among soils, terrestrial ecosystems, and climate change and be available within business hours to work in 3 to 5 hour blocks of time.

### 2. Title: Microbiome influence on prairie plant ecology

**Mentor: James David Bever**

**Description:** Plants (both agricultural and prairie) are strongly affected by the composition of their microbiome, including pathogens and mutualists. Our lab is working to test the importance of these microbiome components in plant community structure, productivity, and grassland restoration.

**Potential Student Tasks:** Will work in greenhouse, laboratory and field settings. Activities include setting up, maintaining and harvesting inoculation experiments,

scoring root infection on microscopes, characterizing soil aggregate stability, extracting DNA from soil or roots, identifying and quantifying plant species in the field.

**Student Qualification Recommendations**: Availability for 3 hour blocks of time during week. Attention to detail.

**3. Title: Ecohydrology Data Science Intern**

**Mentor: Sam Zipper**

**Description:** The HydroEcology of Anthropogenic Landscapes group at the Kansas Geological Survey (HEAL@KGS) is recruiting a student interested in connections between water, ecosystems, and society. There are a number of different projects available that the student could work on, including (i) assessing water sustainability in the Kansas River Basin, (ii) investigating groundwater and surface water in intermittent streams, (iii) investigating crop water use and productivity, and (iv) working on a database of groundwater models. The project(s) that the student ultimately contributes to will depend on the best match for their interests, skills, and active HEAL@KGS research needs.

**Potential Student Tasks:**

The exact tasks will vary based on the project and student experience, but likely include:

- Compiling hydrological data such as streamflow, groundwater levels, and meteorology.
- Conducting data analysis using Excel and/or programming tools.
- Presenting results at group meetings.
- Field data collection may be necessary, depending on the project.
- Working with GIS data may be necessary, depending on the project.

**Student Qualification Recommendations:**

- Available to come to the KGS building on west campus for work purposes.
- Strong time management and independent work skills.
- Coursework and/or interest in water science.

- Experience with programming (R, Python) and/or GIS desirable, but can also learn on the job if needed.

**4. Title: Stable isotope sample preparation**

**Mentor: Marina Suarez**

**Description:** The goals of our research group project(s) are to use stable isotopes to determine the relative age of rocks strata that include important fossils. We also use stable isotopes to determine the kind of environment and climate conditions.

**Potential Student Tasks:** Students may be tasked with crushing samples with a mortar and pestle, drilling powders from rock with a dremel rotary tool, treating samples with acids, and/or weighing samples.

**Student Qualification Recommendations:** Students should be curious about earth sciences, should have at least 1 hour blocks of time available during the week, the ability to take detailed notes, and to work both individually and with others. It is preferred (though not necessarily required) that students have reasonably good eye-hand coordination to handle small samples.

**5. Title: Study of ancient tropical Mississippian (~345 million years old) environments in United States with emphasis on Kansas using carbonate rocks**

**Mentor: Diana Ortega-Ariza**

**Description:** The overall goals of this project are to study Mississippian (~345 million years old) carbonate rocks (limestones and dolostones) from available cores stored at the Kansas Geological Survey and review some literature from United States to determine controls on the distribution of ancient tropical marine environments. Research questions include: Why different ancient shallow-marine deposits developed in certain areas? What are the rock characteristics that indicate normal versus adverse marine conditions in these ancient tropical environments? How did environments change throughout the geologic time interval of study in response to these controls? Controls on environments likely include sea-level changes, movement of tectonic plates, sea currents, and climate. One way scientists can see back into the geologic past is by drilling a deep borehole and capturing a core of the rocks encountered during drilling… A core is a cylinder of rock about two to four inches in diameter and hundreds or thousands of feet long (although it comes out in segments, not one continuous tube).” Drilling | GeoKansas (ku.edu)

During the geologic time period called the Mississippian, most of the continental United States was in a tropical setting and much of the area, including Kansas, were covered by a shallow sea. Organisms different from what we see today swam in this sea and were fossilized in rocks we study in cores. These organisms and other features in the rocks provide the evidence for understanding the environments in which they formed.

In Kansas (and around the world), Mississippian rocks form important petroleum reservoirs (underground accumulations), understanding how these rocks formed, their compositions, and under what environmental conditions could help to improve our understanding of Mississippian time and provide predictive capabilities for petroleum studies. In addition, these rocks are currently being studied to evaluate their potential for long term CO2 storage and reducing the these emissions to the atmosphere and the environmental impact.

The student(s) will assist in describing rocks from KGS cores. They will describe characteristics in rocks such as type of rock, fossils, and physical and biological structures preserved in the rocks. I will train the student(s) in identifying all these characteristics and to fill in a Core Template. No previous experience is needed. Students will also create a database from the literature for locations around the United States that have Mississippian rock data. I will provide the students with the manuscripts, train them for finding additional manuscripts and the type of data to collect from them, and create a database in Excel and place locations (e.g., state, latitude and longitude) on a map in Illustrator and Google Earth.

**Potential Student Tasks:** For rock description from KGS cores, the student(s) will be in the lab identifying and describing rock characteristics and recording that information on a template. Characteristics include type of rock, fossils, physical and biological characteristics. The student(s) will start the rock description at the base (or deepest depth) of the core and will work their way up to the top (shallowest depth) of the core. The student(s) will use a pencil to write down the rock characteristics identified in the core and will make simple drawings on the template. The student(s) will use push pins to identify relevant/important areas on cores (for example: color changes, different shapes) and will take photographs. The student(s) will use an optical hand lens to identify rock characteristic at a higher resolution. Spray bottles filled with water will be available in the lab to make cores wet, so rocks characteristics are easier to see. Diluted hydrochloric acid (HCl) at 10% (safe, can be used without gloves) will also be available to help determining different rock mineralogies. All materials and training will be provided. Overall procedure is shown below:

1) training, explaining characteristics to identify in rocks, I will show them what to identify and how to do it, getting familiar with the KGS core lab and materials (spray water bottles, HCl, microscopes, cores).

2) student(s) will identify some large scale “big picture” rock characteristics in cores. For example: rock color changes, sizes of grains, minerals, and fossils. Students will mark the cores using push pins and record information on the templates. We will discuss findings and questions.

3) student(s) will identify rock characteristics on cores in higher resolution using an optical hand lens and microscopes. Students will mark the cores using push pins and record information on the templates. We will discuss findings and questions.

4) student(s) will describe cores in more detail from base (deepest depth) to top (shallowest depth) and will record information and make simple drawings on templates regarding rock characteristics: composition, fossils, physical and biological structures, and crystals. Students will take photographs of relevant core areas. They will also mark potential areas for further sampling by drawing rectangles with a pencil on the cores. Students will also identify relevant characteristics on the cores by placing push pins along the sides of the cores and will write down these characteristics on the templates. We will discuss findings and questions.

For assistance creating an Excel database and location map in an Illustrator program, the student(s) will collect detailed information from manuscripts from numerous locations in the United States regarding Mississippian carbonate rocks. From the manuscripts, student(s) will find data such as author, year of publication, location (for example: state, latitude and longitude), characteristics of the rocks (for example: type of fossils, type of rocks, interpretations made by the authors regarding environments, ancient geography. The student(s) will collect this information in Excel. Each location will be placed on a map using Illustrator program and Google Earth. No experience on either of these programs is required.

**Student Qualification Recommendations:**

1) attention to detail, organized, patience

2) must be available for ~2 hour blocks of time

3) be ok with getting slightly dirty from working with rocks or wet from the bottle of water, using diluted HCl

4) an interest in fossils, rocks, and geology is a plus

**6. Title: Research assistant**

**Mentor: Gaisheng Liu**

**Description:** The overall goal is to use NMR logging to measure aquifer recharge in lab soil columns. Aquifer is recharged by the infiltration of surface water through the

unsaturated soils. Understanding recharge is critical for sustainable management of groundwater resources. This project will help us understand how the recharge water moves before it reaches the water table. We will set up a few soil columns with different lithologic compositions using large PVC pipes. At the center of large pipes, a small 2-inch pipe will installed for deploying the NMR logging probe. NMR logging will be performed on a weekly basis to understand how soil water changes with time. The NMR-measured water movement will be compared with monitoring of the water seeping out the bottoms of the columns.

**Potential Student Tasks:** The student will participate in the construction of the soil columns. The student will be trained to use the NMR logging tool. Once ready, the student will perform weekly NMR logging of the soil columns. The student will assist in the analysis of the NMR logging data. At the end of the year-long project, the student is expected to present the research results in a poster.

**Student Qualification Recommendations:** The student should be interested in earth sciences, preferably in hydrology. A minimum of 6 hours per week are expected in the lab.

**7. Title: Utilize photographs from the International Ice Patrol to characterize iceberg geometry**

**Mentor: Leigh Stearns**

**Description:** The International Ice Patrol (IIP), founded after the sinking of the Titanic, is tasked with mapping icebergs off of Newfoundland. They rely on military aircraft to patrol and photograph icebergs in the region, but are transitioning to using satellite imagery. Step one is utilizing their archive of digital photographs to create a record of iceberg shape that makes it to this region. Step two is then assessing how well these icebergs are detected in a few different satellite sensors.

**Potential Student Tasks:** The student would use structure-from-motion software to create 3D topography out of multiple aerial photographs. This software is fairly routine to use and relies on a nice GUI interface, but some knowledge of basic coding (python, preferably) would be helpful in analyzing the results. The student would create a database of different iceberg shapes. We will then compare iceberg shapes with those detected in different imagery. The student (with guidance from myself and grad students) will import a range of satellite imagery into QGIS (similar to ArcGIS) and compare iceberg detections from imagery vs the aerial photographs.

**Student Qualification Recommendations:** This project is best suited for a student who is interested in improving their programming skills, and familiarity with remote sensing. They don't need a lot of prior experience, but should have an interest in gaining these new skills. There are 3 graduate students that can provide assistance (in addition to myself), so the student should plan on working in their office for at least 1 hour a week. The remainder of the work could be done remotely.

### 8. Title: Utilizing plant-microbial systems in space

**Mentor: Ben Sikes**

**Description:** The central goal is to understand how microbial systems will respond to space environmental stresses and potentially use microbes, and their interactions with plants to develop biological support systems. One example we've proposed is to create lunar bioreactors to transform lunar regolith into moon "soils" that can then be used to grow plants. The key methods in our lab focus on culturing and sequencing soil microbes, especially fungi, utilizing them in experiments both alone and in association with plants, and then measuring changes in key functions like decomposition, organic matter, plant productivity, and other key soil properties.

**Potential Student Tasks:** Key tasks to start include reculturing fungi to build skills in sterile technique, working with the microbial organisms in a way that is visible, and understanding how they live, grow, and consume/convert substrate. Students often assist with setting up or harvesting experiments, including weighing and other data collection tasks. Depending on interests and ability, some students focus on molecular tools like DNA extraction and gene sequencing. Many students also develop side/independent research projects that build on a larger project to ask a new question(s).

**Student Qualification Recommendations:** Much of the work often needs a 3 hour block of time during the week. We often meet weekly at the start but as students become more independent this can become biweekly or longer. Organization, attention to detail, and ability to learn from mistakes is key. We are all covered in microbes and contamination is an issue, but the key facet is to assess what went wrong and not make the same mistake again. Knowing that failure is an option also is important for scoping and goal setting. For example, don't start a step with all the material you have! On the interests side, we work in the tiny world that is likely playing a big role in the things we care about. Some of our work is on space ideas but the day-to-day is often not flying

into space. Feeling comfortable on working to build something that can be used in the future is important.

**9.Title: Social behavior in a small insect**

**Mentor: Jennifer Gleason**

**Description:** When animals encounter each other, social interactions results. Such interactions include courtship behavior, when males attempt to entice females into mating with them, and aggression between members of the same sex fighting over resources. Emerging Scholars and other undergraduates in the lab have started to piece together the behavior of a species of fruit fly that is very different from the behavior in other species. For example, in studying male remating behavior, we observed that females fight. We are now examining the conditions that induce fighting. The results will have implications for both the evolution of the species and control of a species that is an agricultural pest.

**Potential Student Tasks:** The student will maintain cultures of the flies, sort flies for experiments, and perform experiments. All experiments will involve manipulation of the flies or environmental variables. The student will be completely trained by the advisor, thus no prior experience is needed. As the student becomes familiar with the flies and how they behave, students will have the opportunity to develop new hypotheses and then design and execute the experiments to test the hypotheses. In addition to specific experiments, the student will be expected to contribute to basic lab maintenance (such as making fly food) as all lab members are required to do.

**Student Qualification Recommendations:** The ideal student for this project is excited to learn about evolutionary biology and animal behavior. The student will need to have a set schedule each week, though the exact schedule is flexible during normal working hours. The student must be available during regular working hours for at least three two-hour blocks a week, but fewer, longer blocks are good as well. Attention to detail, organizational skills, and a willingness to ask questions will all contribute to student success. The experiments are not technically difficult but may require some trouble shooting to be executed properly. The student will need to be persistent and not easily discouraged.

**10. Title: Undergraduate research in geochronology by laser ablation ICP-MS**

**Mentor: Andreas Moeller**

**Description:** The laser ablation laboratory in the KU geology department focuses on determining the ages of geological processes. Research questions range from the age and source regions of sediments and sedimentary rocks, to the age of volcanic and plutonic rocks, or the dating of deformation and hydrothermal fluid flow. The aim is to involve students in all stages of the research projects. The student's work may be directly associated with research of the faculty mentor or graduate students

**Potential Student Tasks:** The student's work may include any step between sample collection (likely anywhere between the Rocky Mountains to Arkansas depending on the project), sample processing (rock crushing and mineral separation, selection of rocks for thin section), petrographic characterization and imaging (e.g polarizing microscope, cathodoluminescence microscope), as well as work on the laser ablation system and data interpretation and documentation. Details depend on the chosen project. An anticipated goal is presentation of the research results at professional meetings in the form of posters or talks.

**Student Qualification Recommendations:** Curiosity about state-of-the-art methods in geological research is expected, and sufficient self motivation to carry out multiple preparatory steps before seeing the first data. Close attention to detail and being able to follow detailed instructions for laboratory procedures and safety are essential. Good communication and writing skills are expected, and will also be part of the training and mentoring. Must be available for blocks of time (3-4 hours, half days) to carry out some of the laboratory tasks, and for hour long regular mentoring meetings.

**11. Title: Archiving and Data Management in STEM Research**

**Mentor: Nikki Potter**

**Description:** Data management is a frequent problem in STEM related fields. How do we capture the data from current and past researchers to make it accessible and archived for future use? Often data is lost when a researcher leaves an institution because they do not have a way to preserve or pass their research on to others. The student will work with the Library Manager/Archivist on a project that has two components to it 1) Sort and assess material from Kansas Geological scientists to see if the documents contain pertain data that should be organized, scanned, and archived/preserved for current and future use. 2) Assist scientists with new data management plans for new projects as they collect data—help them fill out the who, what, when, where, and why of the project and aid in the integration their final data into the KGS Archive database.

**Potential Student Tasks:** Organize, sort, and rehouse materials in boxes from scientists; arrangement of records within folders and folders within collections; describing collection contents; checking collections against descriptive listings for accuracy; and creation of accurate collection listings in an Excel sheet. Move boxes into archives for long-term storage. Digitize material as needed. Create new data management plans for current scientists with the assistance of the librarian. If we have the time, assist in the creation of new exhibit displays at the Kansas Geological Survey.

**Student Qualification Recommendations:**

1. Time commitment: Must be available at least 3 hour blocks of time in-person.

2. Characteristics: Ability to be accuracy, have attention to detail, and be able to concentrate for long periods of time. The ability to work independently. Familiar with Word and Excel Physical Requirements: Ability to tolerate working environment that may be dusty. Ability to bend, stretch, lift and move boxes, folders, and objects up to 40 pounds with or without accommodations.

3) Have an interest in libraries, archives, data management, museum studies or preservation. Majoring in Geology, Geography, Environmental Science, or related field.

## 12. Title: Exploring the spectral structure of ecosystem functioning

**Mentor: Daniel Reuman**

**Description:** “Ecosystem functioning” refers to any of a large number of aggregate functional variables that can be measures for an ecosystem and may fluctuate over time. For instance, total productivity of plants in a grassland is a variable that can fluctuate substantially from year to year, and to which all the plant species in the system contribute. Other ecosystem functions include carbon storage, nutrient retention and cycling, and many others. Some ecosystem functions are also “ecosystem services” in the sense of providing a direct service or product to humans. If the grassland system mentioned above is also a pasture, the service provided is food for livestock. It can often be better if ecosystem functions and services are stable through time, rather than fluctuating erratically. Also the stability or instability of ecosystem functions, and factors that make ecosystems stable or unstable, have been much studied, researchers have looked very little at whether ecosystem functions tend to fluctuate predominantly on long or short timescales, and what aspects of the ecosystem and the environment may make that difference. Whether or not an ecosystem function can be expected to change rapid from one year to the next, versus changing just as much but doing it over a longer period of time, can also make a difference for other components of the ecosystem and for human uses of ecosystems. In this project, the student will explore broadly this

general question, with the potential to focus on one of several different sub-projects depending on interest.

**Potential Student Tasks:** Depending on the sub-project selected, the student may do literature surveys; may seek to create a database with data on different types of ecosystem function measured through time; may learn and then write computer code to perform analyses of ecosystem function data obtained; and may work with members of the Reuman lab to interpret and understand results. Aspects of the project based on mapping and ecosystem functioning measurements taken from space through remote sensing may also be developed for students interested in substantially building their data manipulation and analysis skills.

**Student Qualification Recommendations:** Successful students will have a quantitative mindset, including a willingness to work with data and learn computing methods aimed at data analysis. No specific computing or statistical experience is required, but an interest in and some aptitude with quantitative or mathematical subject matter is important.

**13. Title: Utilizing benthic foraminiferal data to assess major storm events**

**Mentors: Scott Ishman and Belkasim Kh. KHAMEISS**

**Description:** This project will provide mentoring on the scientific method from sample processing to presentation using micropaleontological samples. Florida Bay is a shallow marine environment occurring between coastal south Florida and the Florida Keys. Within Florida Bay are numerous exposed mud banks and small islands (keys) that are impacted by climate change and sea level rise. Living within Florida Bay are a group of single-celled organisms called foraminifera. Foraminifera produce a shell that is preserved in sediments. The preserved shells can be used to interpret what the conditions were like in the environment when the foraminifera were living. Previous work has examined sediment cores from select keys within Florida Bay to assess the impact of sea level rise and climate variability, including hurricane frequency, on these features. The scientific goal of this project is to study foraminifera recovered from hurricane deposited samples from Florida Bay to determine which species or groups of species of foraminifera are indicative of hurricane deposits. The results can be used to identify past hurricane events recorded in the previously studied sediment cores to determine storm frequency and its relationship to climate change.

**Potential Student Tasks:**

1-Sieving sediment samples to recover foraminifera.

2-Using a microscope to separate foraminifera from fine grained sediments.

3-Identification of foraminifera and counting the abundances of species occurrences.

4-Documenting the foraminifera species occurrences using Scanning Electron Microscopy and Imaging.

5-Analyzing data and presenting results.

**Student Qualification Recommendations:**

1-Courses in paleontology and sedimentology.

2-Students Interested in the study of paleontology/micropaleontology and climate change.

3-Available for a minimum of 2-hour blocks of time at least 3 days a week.

4-Attention to detail, good observation skills and patience.

**14. Title: Assessment of Biosignature Preservation and Detection in Oolitic Hematites**

**Mentor: C Marshall**

**Description:** Hematite is a known and important component of Martian surface mineralogy. The origin of hematite detected in Martian surface materials is commonly attributed to weathering processes, or aqueous precipitation, or form from oxidation of glassy basalt flows. Given the mixture of evaporative and eolian processes, this would suggest that oolitic grains should be expected within the sediments on Mars. Here on Earth, oolitic hematite is a marine biochemical sedimentary rock with syndepositional iron enrichment, that is texturally composed of tiny round spheres of chemically precipitated hematite, that has long been viewed as a geologic curiosity. Despite the extensive distribution of oolitic hematite deposits, the origin and conditions of their formation is still under considerable debate. Currently, it is postulated that these enigmatic deposits are mineralogically composed of hematite, chamosite, or iron oxyhydroxides. Likewise, little is known about the temperature of the fluids, and whether biological or non-biological processes occurred to induce the precipitation and hence formation of these deposits. Therefore, in order to shed light on the formation conditions of these deposits, a systematic approach will be undertaken to reveal the mineralogy, chemistry, and biosignature content of oolitic hematite samples located in the USA. The mineralogy and chemistry of inorganic phases present in the oolitic hematite will be elucidated by Scanning Electron Microscopy and coupled Elemental analysis, Raman spectroscopy, and X-ray Diffraction. To determine the biosignatures present,

microscopy will be employed for morphological analysis and Raman and Infrared spectroscopies will be used to elucidate the chemical and preservation potential of biosignature materials. Students will be mentored in the spectroscopy and microscopy components of this project.

**Potential Student Tasks:** Students working on this project will be tasked with collecting Raman spectra on oolitic hematite samples, both on hand samples and thin sections. Investigating morphological features on thin sections of oolitic hematite by microscopy. Collecting Infrared spectra on thin sections of oolitic hematite. And lastly, collecting Scanning Electron Microscopy images and undertaking elemental analysis.

**Student Qualification Recommendations:** Students with an interest in astrobiology, planetary geology, mineralogy, geobiology, and geochemistry are encouraged to apply to this BESST project. Students are expected to devote a 3 hour block of time weekly to undertake research in the lab and meet with the lab group. Students with a professional goal of becoming an astrobiologist or planetary scientist are encouraged to apply.

**15. Title: Genetics of flower diversity**

**Mentor: Lena Hileman**

**Description:** Hileman lab members work as a team to determine how genetic programs evolve to allow plants to adapt to different pollinators. We primarily work on a group of plants that have evolved flowers adapted to hummingbird pollination multiple times from an ancestral condition of adaptation to bee pollination. Hummingbird-adapted flowers are red, narrowly tubular, have reproductive organs that are exerted out of the flower to contact the hummingbird's head, produce copious amounts of nectar and have lost the bee landing platform that is usually formed by the lower petals. Bee-adapted flowers are bluish-purple, widely tubular, have reproductive organs nestled inside the flower, produce small amounts of nectar, and have a conspicuous landing platform to help guide bees into the flower. We aim to understand how changes to genes determine these complex differences in flowers. Specific tasks for this position will be matched to student interests (see section on potential tasks and responsibilities). Undergraduate students work closely with graduate students in the Hileman lab such that data collected by undergraduates contributes an important piece of the puzzle to a larger project lead by a graduate student. Undergraduates who demonstrate a strong commitment to research can move into more independent research projects if they choose.

**Potential Student Tasks:** A range of tasks are associated with this position and specific tasks will be determined based on student interest. all of these tasks can be

learned in stages, starting from novice to advanced abilities. Tasks include 1) Plant care: watering/fertilizing/pollinating/seed collection in greenhouse setting. 2) Flower trait measurements: overall measurements of length and width for different parts of the flowers and nectary volume measurements, photographing mounted flowers for later digital image analysis, photographing floral organs under the microscope for later digital image analysis, and digital image analysis of previously photographed flowers/parts using imageJ software. 3) DNA/RNA work: DNA and RNA extractions, quantification, and genetic analyses using PCR-based approaches. 4) Bioinformatics: identifying genes in genome sequences of our study species, identifying differences between species, and placing interesting genes into phylogenetic contexts using information from international gene and genome databases.

**Student Qualification Recommendations:** The successful student in this position will be enthusiastic about the work, have strong organizational and note taking skills, able to keep to an agreed upon schedule (especially for plant care!), and able to work a few hours a week in the morning for plant care (one or two mornings per week ideally).

**16. Title: Geophysics Student Computer Programmer**

**Mentor: Noel M Bartlow**

**Description:** The Bartlow Crustal Deformation Group at KU performs research in how the crust of the earth moves in response to tectonic forces. Our main goal is to better understand earthquake hazards and the geologic processes that cause them. We mainly use tools from math and computer programming to analyze data from national and international networks of high-precision scientific instruments, capable of measuring very small motions of Earth's crust. By analyzing slight changes in these small motions we make discoveries about the physics of earthquake causing geologic faults. More info at http://bartlowcrustaldef.com/

We are looking for a student with a strong background in math and experience with computer programming to help automate some of our data gathering and data correction processes. Codes to help automate these processes would be used by Professor Bartlow and her graduate students to accelerate research. The student will also have the opportunity to participate in group meetings and scientific discussions, and receive mentoring from Prof. Bartlow, a female scientist in a physical science discipline.

**Potential Student Tasks:** The main task a student will be asked to do is write computer codes to automate some data retrieval and cleaning processes for our group. To start with, this will likely mean using UNIX scripting to write brief scripts that use curl or wget commands to grab data and store it in a shared folder. Later we would work up to using

MATLAB or Python to perform more advanced data cleaning tasks, such as outlier and offset removal.

**Student Qualification Recommendations:** Some prior computer programming experience and interest in computer programming for scientific applications are necessary. While specific experience with UNIX commands and/or MATLAB is preferred, experience in any programming language along with the skills and ability to learn new things given documentation will work well. Students should also have solid communication and organizational skills, and be willing and able to take constructive feedback and function as part of a team. Students should expect to meet with the professor 1-on-1 every 2 weeks and as part of a team meeting every 2 weeks. Meeting times and work times are flexible. Interest in physics, geophysics, and/or natural hazards is helpful.

**17. Title: What do Kansas Earthquakes and Climate Change Have in Common?**

**Mentor: George Tsoflias**

**Description:** When we think of earthquakes we think of California. However, in the last decade a large number of earthquakes have occurred in Kansas and Oklahoma. Those earthquakes are created by human activity, by injecting waste fluids in deep wells in the subsurface. In the coming years large volumes of CO2 need to be removed from the atmosphere to combat climate change. Geologic storage of CO2, i.e. injection in the subsurface, is a technology currently being developed but it poses the risk of creating earthquakes. In this project we use a network of seismic sensors installed at Bushton KS (central Kansas) to detect earthquakes, pinpoint their location and measure their magnitude. Bushton is a likely site for future CO2 injections. This project establishes pre-injection (background) natural seismicity levels.

**Potential Student Tasks:** The student will work in a team with a graduate student and a faculty mentor, and will learn the methods we use to analyze data for detection of earthquakes. The data is in digital form and it is handled by computer. Typical tasks involve downloading data from the network, reformatting data and reading it into the software for analysis, visual observation of the data, identification of earthquakes, analysis of earthquakes for determination of location and magnitude. In addition, we conduct visits to the network at Bushton KS for routine maintenance. The student applicant will be involved in all aspects of the research as the other team members. Students spend most of their time at the Geophysics Lab in G170 Slawson Hall on KU main campus. Hybrid (i.e. in-person and remote) work is possible.

**Student Qualification Recommendations:** No prior knowledge in earthquake research is needed. The student should have an interest in physical sciences and curiosity on how natural processes work and affect our lives. Detail oriented and organized. Ability to work well with others. This is a team project and our work depends on the work of others. Reliable, responsible and able to complete tasks within the timeframe agreed. Work hours are flexible, but overlap with other students is essential for communication and training. Once initial training is completed some tasks can be completed remotely (hybrid). Tasks can be completed is short (1 to 2-hour) segments or longer, depending on student availability.

### 18. Title: Assessing Critical Element Enrichment in MVT Deposits and Mine Tailings of the Tri-State Mining District

**Mentor: Ibukun Bode**

**Description:** This project is an initial resource assessment to evaluate the concentrations of rare earth elements (REEs) in rocks previously mined for Lead-Zinc in the Tri-State Mining District. These REEs have emerged as a top priority among various industries, especially those involved with energy transition, communication, and U.S. national security. However, significant knowledge gaps exist in the current scientific understanding of REE distribution and process controls in certain rock deposits. We intend to assess REE concentrations in the study area, investigate factors that influence mineralization, and identify rock properties that can be used as proxies to find REEs in similar rock deposits.

**Potential Student Tasks:** We have two student researcher openings: one for a student focusing on acquiring and processing geochemical rock data and the other for a student with a geochemical data analysis emphasis. We will provide adequate training for lab protocol, foundational instrumentation and method theory, and data processing methods to all students regardless of focus. Importantly, this opportunity will guide student researchers through the scientific methods and assist each participant independently formulate exciting research questions and hypotheses. The initial laboratory task will be measuring elemental concentrations and rock properties. The research student focusing on data acquisition will subsequently provide their processed data and initial results and work with the PI to select samples with the highest REE concentrations. For data analysis, initial assignments will begin with using Microsoft excel to collate and build a database with previously acquired rock composition data. Subsequently, the research student will utilize analytical and visualization functions in excel and other data tools to present rock data and indicate mineralization trends within the various rock deposits in the study area.

**Student Qualification Recommendations:** We seek scientifically curious students with eye for detail and interests in (1) working in a lab environment to acquire and process precise scientific data. Or (2) using statistical methods to analyze, present, and draw conclusions from scientific data. Lab research will require handling numerous samples from multiple locations — research students with solid data management, labeling, and sorting skills will enjoy working in this environment. We will conduct multifaceted and collaborative research— hence we welcome applications from students with diverse strengths or interests in earth and environmental sciences, chemistry, physics, statistics, and data analytics. Students are required to meet weekly to provide progress reports. Laboratory work scheduling will be flexible and scheduled in two-week increments to accommodate student calendar changes. The student will be required to meet weekly to provide progress reports. Laboratory work scheduling will be flexible and scheduled in two-week increments to accommodate student calendar changes. Lastly, this will be a dynamic research environment and an opportunity to engage in seminal research that will inspire your scientific curiosity and future professional goals. Visit the critical minerals and materials program on DOE.gov to learn more about REEs!

**19. Title: Mycorrhizal fungi of the tallgrass prairie and beyond**

**Mentor: Liz Koziol**

**Description:** The student will assist with research projects that investigate mycorrhizal fungi, which are a group of soil-borne fungi found in almost any habitat worldwide. These fungi partner with many plant species by colonizing roots and producing hyphae in the soil. Here at KU, we maintain INVAM, the largest collection of arbuscular mycorrhizal fungi in the world with 900 isolates (https://invam.ku.edu/). We also maintain a collection of fungi endemic to tallgrass prairie of Kansas and beyond. Generally, we are interested in plant-soil mutualisms and how microbes maintain plant community diversity and productivity. We utilize these fungi within prairie restoration experiments and in manipulative field and greenhouse experiments. Our lab website represents our research well (https://beverlab.ku.edu/).

**Potential Student Tasks:** The position is flexible and could involve some combination of laboratory, greenhouse and/or field work. Laboratory work would include isolating, identifying, and quantifying fungal structures in the microscope, isolating root fragments for DNA amplification. Greenhouse work could include culture initiation up, monitoring, and plant and fungal harvesting. Field experiment tasks would involve monitoring plant community composition, weighing plant biomass, and assessing soil properties. Students will gain experience with the scientific method and lab techniques including plant propagation, fungal isolation, sterile technique, and many others. Many of our past undergraduate students have used their research experiences in our lab to conduct

independent research projects and honors thesis projects in addition to going on to graduate school or medical school, to careers in industry as lab mangers and quality control technicians, and other diverse fields.

**Student Qualification Recommendations:** The ideal candidate would be comfortable across a range of working environments, such as in field, dirt lab, greenhouse, and molecular laboratory settings. Our work is varied, and the ideal candidate would work well across these varied environments. Knowledge of prairie species or mycorrhizal fungi is not necessary. Our lab is currently a partnership of three professors (Drs. Liz Koziol, James Bever and Peggy Schultz), four post-doctoral scholars, six graduate students, ten undergraduate student helpers and a full-time lab technician. Thus, the ideal candidate would work well with others. Due to this large laboratory working group, there are several different research project that the candidate could participate on—to be determined as the student's interests develop over time. Previous lab experience is not required. Initially, we will start off students with basic tasks, such as weighing plant biomass and collecting fungal spores from soil, and gradually progress to more complicated tasks as the new student acquires skills. However, a willingness to learn new techniques and to operate in a sterile environment, such as a molecular space, is required. Our research is very much hands on and ideally, students would attend lab in person with blocks of time of 2 hours or more 2-4 days a week any time between 9-5 M-F.

**20. Title: Development of heat tracer to the PVP suite of instruments**

**Mentor: J.F. Devlin**

**Description:** PVP instruments currently rely on solution tracers to sense groundwater movement. In order to increase the depth range these instruments can be used, heat tracers offer several advantages. This program will undertake the identification of sensors, develop methods to install them in PVP instruments, and assess their performance.

**Potential Student Tasks:**

1) liaise with suppliers

2) train on current instruments

3) liaise with Solinst, Canada, on prototypes

4) 3D print in-house probes to aid with design

5) perform laboratory tests using current probes and heat sensing probes to assess performance

6) attend weekly research group meetings and participate as needed

**Student Qualification Recommendations:** Students with an interest in instrumentation, and who possess good communication skills for interactions with suppliers and commercial instrument developers are sought. Some experience with practical skills such as soldering, computing, and writing would be advantageous. Self-motivation and work ethic, as well as patience arealso a virtues.

**21. Title: Improving the Pennsylvanian chronostratigraphic framework in the Midcontinent of North America**

**Mentor: Stephan Oborny**

**Description:** The focus of this research is to improve upon the chronostratigraphic framework of the Pennsylvanian succession in North America through the establishment of a high-resolution (i.e., 6 to 12 inch sampling resolution) carbonate carbon and organic carbon isotopic record. The new chemostratigraphic data produced by this work will be the first of its kind for this part of the Paleozoic succession in North America and globally, will be tied into well-established biostratigraphic zonations, and will significantly improve the chronostratigraphic framework for this part of Earth history.

**Potential Student Tasks:** Students will be trained to collect samples for carbonate carbon and organic carbon isotopic analysis. Optional: Students will have an opportunity to present their work at a regional or national conference. Optional: Students will have the opportunity to publish their findings as first author.

**Student Qualification Recommendations:** Students must be available in 3-to-4 hour blocks at the Kansas Geological Survey located on KUs west campus. Sampling requires some attention to detail. Students will be using a drill to collect powder from rock material, this will create some dust... students will be provided with appropriate dust masks and PPE. Students will need to be able to lift 30-to-40 pound boxes of core without issue. This research provides an opportunity for students to gain mentoring from multiple KGS faculty and scientists and could assist students with their marketability to graduate programs.