EARTH, ENVIRONMENTAL & PLANETARY SCIENCES

SPRING NEWSLETTER 2025

Terra Firma

ENVIRONMENTAL CORE REFLECTED IN DEPARTMENT NAME CHANGE

As tectonic plates shift over time, so does scientific focus evolve for researchers chronicling the forces that shape the Earth and other planets. UT's Department of Earth, Environmental, and Planetary Sciences (EEPS) added the "environmental" element to its name in spring 2024 to expand on its existing mission and research initiatives with an eye for future growth.

"**Our science won't change—planetary geoscience and Earth's past, present, and future remain our focus, but the new name encompasses all that we do, including addressing present and future environmental challenges**," said Department Head and Jones/Bibee Professor Alycia Stigall. "**Our faculty and students are engaging in these critical issues in important and ever-expanding ways**."

Geosciences have been a core discipline taught at UT since 1879, when studies were part of the School of Natural Science and Geology. Known as the Department of Earth and Planetary Sciences for the past 20 years, its faculty and students have engaged in internationally recognized research and teaching about planetary geoscience and the full range of geological disciplines from paleontology and Earth's history to geochemistry, volcanology, and hydrogeology.

All these areas increasingly encompass environmental geoscience. Currently, more than half of current undergraduate majors are in the environmental studies and water science concentrations.

Many graduate students and faculty engage in environmental geoscience research, and many graduates gain employment in the rapidly growing environmental geoscience employment sector, which has a projected workforce growth of 8.4% by 2029.

"**Environmental geoscience is an area that is central to who we are as a department today, and it's essential to our future**," said Stigall. "**Our goal is to provide outstanding job preparation for our students to engage in the workforce of Tennessee and the world while also engaging in research that tackles some of the most challenging issues that impact societies today**."

EEPS provides outstanding interdisciplinary pathways for students to prepare for a career in the environmental geoscience field, including concentrations and minors in environmental studies, water science, geology, planetary geoscience, and (starting in fall 2025) paleontology. The department also recently launched a week-long field course program that provides students in any concentration the opportunity for an intensive field training course. Through this program, students have access to a set of rotating field experiences to hone their skills throughout their degree program.

"Our students also have access to unparalleled opportunities to engage in innovative, leading-edge scientific research," said Stigall. "Possibilities range from driving Mars rovers to obtaining measurements with a world-class instrumentation suite to gathering data on the mountains, rocks, fossils, and rivers of Tennessee."

The new EEPS name will provide additional visibility within the scientific community, and with funding agencies, for faculty already engaged in environmental geoscience. It will also help attract new faculty with an environmental research focus.

"**A departmental identity of earth, environmental, and planetary sciences clearly communicates the centrality of environmental science to the present and future mission of the department**," said Stigall. "**It will aid in recruiting the best and brightest faculty and graduate students to expand this important work**."

MESSAGE FROM DEPARTMENT HEAD

EEPS IS GROWING OPPORTUNITIES AND IMPACT

Alycia Stigall
Department Head

It's a pleasure to share some of the incredible achievements of the Department of Earth, Environmental, and Planetary Sciences here at University of Tennessee, Knoxville, over the past year with you.

We are building on a strong foundation with a new name that more fully reflects the geoscience we do today, including addressing environmental challenges. Our name reflects our position as a department on the rise and is accompanied by positive momentum on multiple fronts, including an expanding faculty and facilities.

Since January 2024, the department installed new analytical equipment, including an electron microprobe, desktop scanning electron microscope, and laser ablation and ICP-MS systems.

We were thrilled to welcome two new tenure-line faculty, a hydrogeologist and a structural geologist, and we are recruiting faculty members in energy transition geoscience and critical minerals geology. These new faculty will allow our department to even more deeply engage with issues of societal importance and resource utilization.

Connecting research and teaching to areas that make life and lives better for Tennesseans, the country, and the world is a core mission of the UT, and one in which geoscience is central. Over the past year, our faculty expanded their impact as leaders of cross-disciplinary research centers housed within the College of Arts and Sciences, including the Institute for Climate and Community Resilience, the Collaborative for Animal Behavior, and the Center for Planetary Science and Exploration. The latter is a successor to the Planetary Geoscience Institute, but with a broader mission to build interdisciplinary collaborations in pursuit of proposing large projects as well as the robust outreach program of the Tennessee Space Grant Consortium. These centers are catalysts to develop innovative, dynamic teams to explore some of the most important issues facing society.

Our students also are engaging in transformative opportunities and making incredible contributions, including starting a new Society of Economic Geologists chapter. A high percentage of our undergraduates engage in research and present at meetings such as Tennessee Academy of Science, Geological Society of America (GSA), Lunar and Planetary Science Conference (LPSC), and Society of Vertebrate Paleontology.

Spring 2024 marked the return of a departmental field geology course, where 17 students engaged on a transect across the Appalachian Basin from distal sedimentary units in Kentucky through the Piedmont of Virginia. This year's class will explore the geology of Arizona. We are continuously working to provide high quality programs that engage students and prepare them for productive careers.

The EEPS Alumni Advisory Board includes incredibly dedicated and supportive individuals. Over the past year, we hosted alumni receptions at GSA and LPSC, visited with alumni in Houston, and welcomed our board members to campus for meetings and Geoscience Career Day. I hope that you will join us for a future event at a conference, on campus, or near your home. Check our website for information about events such as this spring's Klepser Lecture Series.

The continued support of our alumni and friends is critical to ensuring the success of our students and faculty. We are grateful for you.

Please email me or your favorite faculty member so we can share your updates, and visit Strong Hall when you are in Knoxville.

GO VOLS!

ALYCIA STIGALL
Department Head

A 2024 field geology course took 17 students across the Appalachian Basin. This year's class will explore the geology of Arizona.

Learn about the new cross-disciplinary research centers and more with links in our digital newsletter.

FACULTY PROFILES

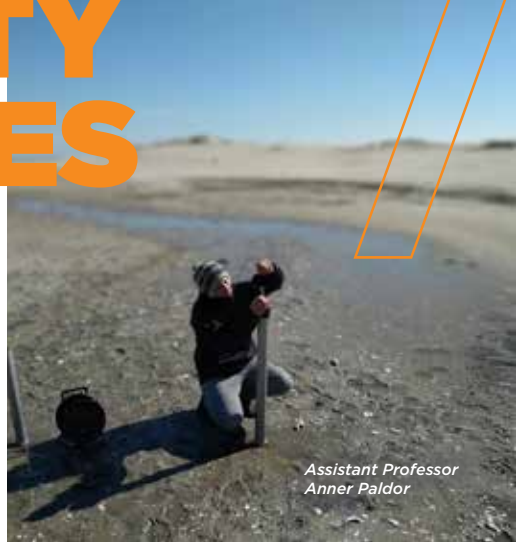
Structural Geologist Explores from Andes to Canada

CHELSEA MACKAMAN-LOFLAND joined the faculty this academic year as our new assistant professor in structural geology and tectonics. Her research program seeks to understand how crustal, surface, and tectonic processes deform and shape Earth's continents.

She comes to us after holding appointments as an assistant professor at Denison University, a National Science Foundation (NSF) postdoctoral fellow at the University of Connecticut, and an NSF graduate research fellow at the University of Texas at Austin.

Her research brings together a variety of methods, including geochronology, thermochronology, stable isotope geochemistry, and numerical (structural, geodynamic) modeling, in a way that is grounded in field-based techniques, from structural mapping and basin analysis to balanced cross-section construction.

She has ongoing projects exploring the complex tectonic history and seismic hazards of the southern central Andes and comparing processes observed there to the North American Cordillera. Other research directions investigate the relationships among thrust belt evolution in ancient and active mountain ranges, and the depositional records preserved in the sediments of adjacent foreland basins. She is actively addressing these questions within the Canadian fold-thrust belt, and is excited by related opportunities closer to home, in the southern Appalachian Mountains.



Assistant Professor Anner Paldor

Mackaman-Lofland also brings a passion for Earth science education, especially making field experiences and methods more accessible for students across all experience levels and backgrounds. Her teaching is motivated by the knowledge that the world needs Earth scientists, and global citizens in other fields who understand Earth processes, to tackle the major societal challenges of obtaining natural resources, mitigating natural hazards, and managing habitats, including those of humans. She is committed to engaging and providing experiential learning opportunities for students and mentees spanning introductory through graduate levels.

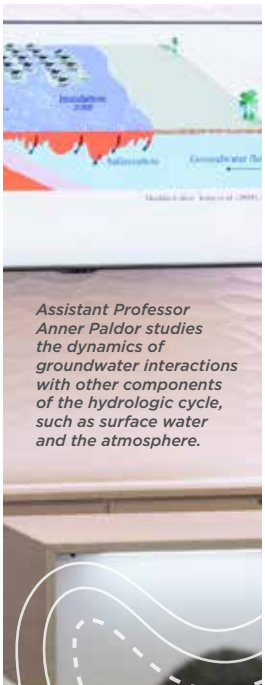
Assistant Professor Chelsea Mackaman-Lofland is a structural geologist with projects in the Rockies and the Andes.

Hydrogeologist Focused on Freshwater Supplies

ANNER PALDOR is a hydrogeologist who joined EEPS in summer 2024. He came from the University of Delaware, where he spent five years as a postdoctoral researcher and an associate scientist. Before that, Paldor spent his entire life in Israel and completed his undergraduate and graduate degrees in geology and hydrology at Hebrew University of Jerusalem. Although he grew up near some of the best beaches in the world, Paldor is much more of a mountain person, which is why he was thrilled to move to Knoxville and UT.

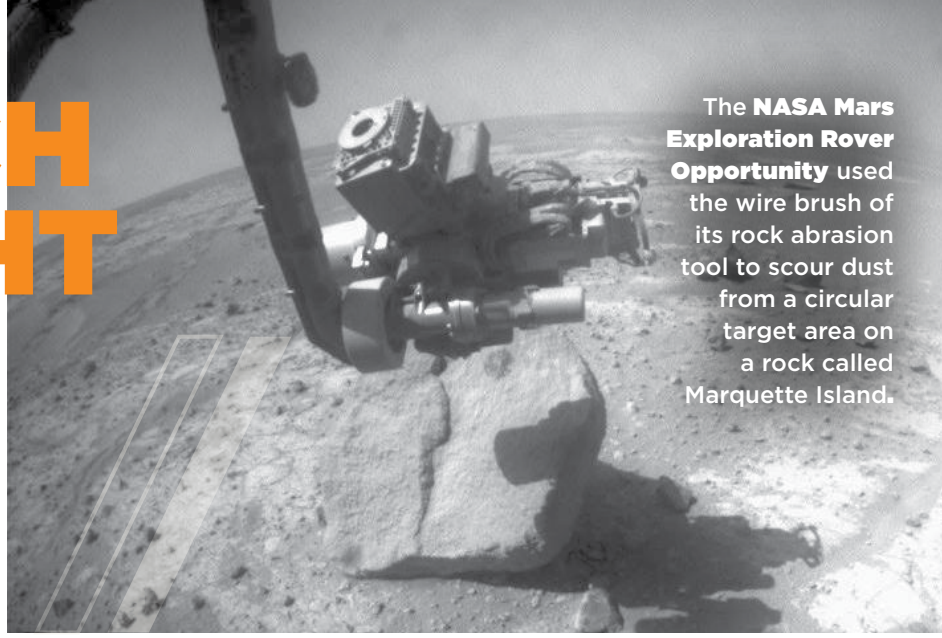
His research focuses on the dynamics of groundwater interactions with surface water and the atmosphere. He is interested in how future freshwater supplies will be impacted by changes (in space and time) in these interactions that occur over multiple scales and across settings—from headwaters to coasts and to the oceans. Paldor primarily uses physics-based and statistical modeling, combined with fieldwork and geospatial analyses. Coming from a semi-arid region, he is excited about transformative research to inform policymakers and stakeholders on water resources management, coastal resilience, and earth-surface stability under changing conditions.

Paldor teaches courses on hydrology, hydrologic modeling, and environmental issues related to hydrological systems. He is passionate about teaching and sees in it an important way to indirectly increase societal preparedness for environmental challenges by training young professionals in the field of hydrology.



Assistant Professor Anner Paldor studies the dynamics of groundwater interactions with other components of the hydrologic cycle, such as surface water and the atmosphere.

STUDENT RESEARCH SPOTLIGHT



The **NASA Mars Exploration Rover Opportunity** used the wire brush of its rock abrasion tool to scour dust from a circular target area on a rock called Marquette Island.

MARS ROVER DATA YIELDS NEW FINDINGS

When the Mars Exploration Rover (MER) Opportunity landed on the red planet in 2004, its nominal mission was planned to last only a few months. Instead, the rover stayed active on Mars, sending back images and data for analysis until 2018.

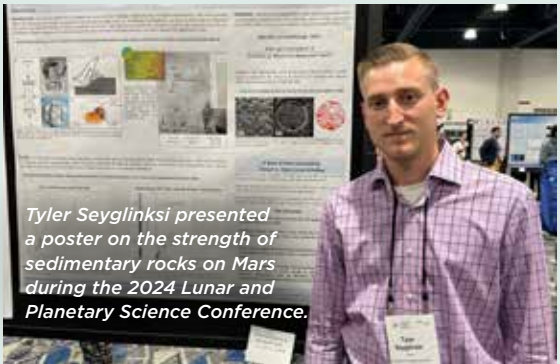
EEPS has a long history with the MER missions, with Professors Hap McSween and Jeff Moersch both having worked on the missions. Now, researchers including **TYLER SEYGLINSKI** (MS geology '24) are making new and unexpected discoveries based on Opportunity's amazing run.

Studying under Assistant Professor Brad Thomson, Seyglinski worked with a legacy dataset from Opportunity, tracking energy consumed by the rover's Rock Abrasion Tool (RAT). This device was used to grind down the surface of rocks on Mars to provide fresh, unweathered surfaces for further analysis.

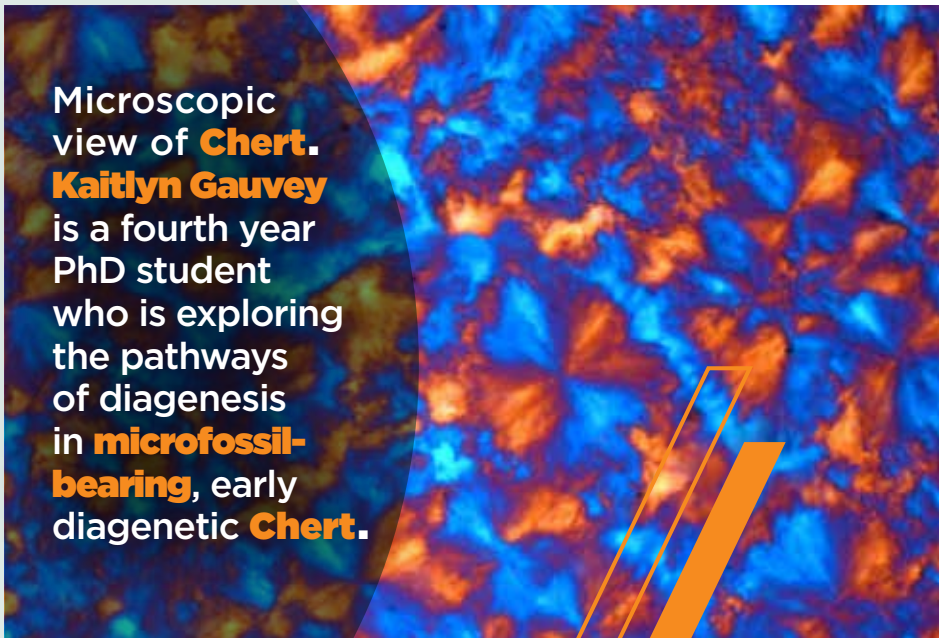
As it turns out, there was a strong correlation between the energy RAT used to abrade a surface and the sampled rock's strength and porosity. Seyglinski used the recorded motor energy expended to estimate rock strength. He also mentored undergraduate students Kenzie Dale and Anna Nichols to help collect porosity data. In the end, the data provided the foundation for his thesis, which he defended in May 2024. Seyglinski's results indicate that the sampled rocks were weakly lithified and likely experienced only shallow burial, based solely on RAT energy consumption.

Tyler Seyglinksi stands over Lake Louise in Banff National Park.

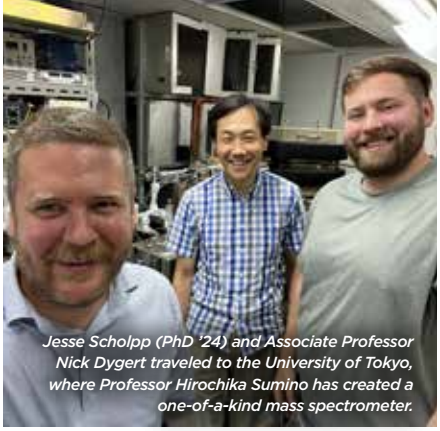
Gauvey at microscope



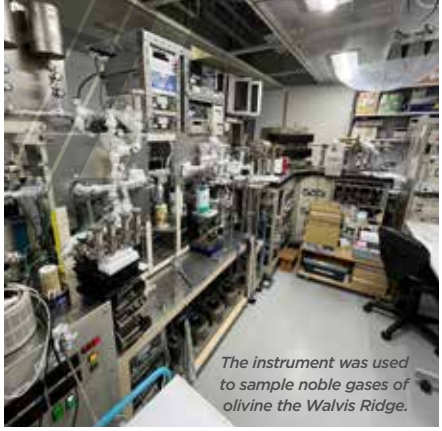
Tyler Seyglinksi presented a poster on the strength of sedimentary rocks on Mars during the 2024 Lunar and Planetary Science Conference.



Microscopic view of **Chert**. **Kaitlyn Gauvey** is a fourth year PhD student who is exploring the pathways of diagenesis in **microfossil-bearing**, early diagenetic **Chert**.



Jesse Scholpp (PhD '24) and Associate Professor Nick Dygert traveled to the University of Tokyo, where Professor Hirochika Sumino has created a one-of-a-kind mass spectrometer.



The instrument was used to sample noble gases of olivine the Walvis Ridge.

WALVIS RIDGE SAMPLE YIELDS NEW ANALYSIS

Understanding the complex origins of the Walvis Ridge hotspot took Jesse Scholpp (PhD '24) across three continents, and yet none of that was highlighted in the dissertation on lunar rocks he defended in December. Instead, the international collaboration (with team members from the US, Canada, Germany, England, and Japan) started as a side project.

In 2021, Scholpp joined his master's advisor John Shervais and another of his former students, Katie Potter, in South Africa to study the origins of the Walvis Ridge. This geologic structure is unusual, appearing like a single hotspot (initiating about 130 million years ago) that split into three (about 70 million years ago) during the breakup of Gondwana and the expansion of the southern Atlantic, as South America and Africa split apart. How and why that might have happened are hotly contested.

The team spent two weeks in quarantine in South Africa before embarking, because the Omicron variant of the COVID-19 virus was just picking up speed. Despite the precaution, they had to turn around when one of their collaborators tested positive mid-voyage. Back at the ridge, they drilled for samples in about 4,000 meters of water and an additional 500 meters of rock, under the watchful eyes of a variety of seals, whales, and at least one seemingly lost penguin.

The samples first were taken to the University of Alberta, where they were blasted with high voltage to separate the minerals in the rock. Then, each grain of olivine needed to be separated from the other minerals by hand. After that, Scholpp and EEPS advisor Nick Dygert, the Lawrence and Dawn Taylor Associate Professor of Planetary Geosciences, took the olivine to the University of Tokyo and a one-of-a-kind mass spectrometer, designed and built by their collaborator, Professor Hirochika Sumino.

Most mass spectrometers require a different sample to assess each noble gas present in a rock, a process that requires significant time and a large number of specimens. Sumino's mass spectrometer could analyze each gas from a single specimen, cycling one sample through a process that crushed the grains to fracture them, heated them to release the noble gases, sent that through a purification system to separate the gases, and then analyzed each gas in turn to get relative abundances and isotope ratios.

The results were surprising. Previous interpretations had suggested that all three plumes of the Walvis Ridge formed at the same time, diverging from the initial mantle plume that possibly initiated the breakup of Gondwana into a triplet of neighboring hot spots. The noble gases held in the sampled olivines told a different story.

In this new research, only the central track preserves a primordial helium-3 isotope anomaly consistent with mantle plume origins. The two side tracks appear more degassed, yielding noble gas isotopic signatures more similar to those seen in the mid-Atlantic Ridge. This suggests that these two were subplumes, whose chemical signatures shifted as they incorporated more material from the upper mantle.

This work reframes the history and formation of Walvis Ridge, and all this "side-project" took was travel across three continents and access to wholly unique equipment.

DIAGENESIS PATHS SHOWN IN MICROFOSSIL-BEARING CHERT

In early diagenetic chert we commonly find detailed preservation of the cellular structures of microbes that made up our earliest ecosystems. However, that fossil preservation is subject to modification over thousands—to billions—of years of post-depositional fluid flow.

Kaitlyn Gauvey is a fourth year PhD student who is exploring the pathways of diagenesis in microfossil-bearing, early diagenetic chert with her advisor, Linda Kah, the EEPS Kenneth R. Walker Professor. Earlier in the Kah Lab, Jeremy Dunham (MS '18) and Ashley Manning-Berg (PhD '18) noted that microfossiliferous chert of the 1.1 billion-year-old Angmaat Formation, Northern Baffin Island, preserved a through-going rectilinear microfabric when examined under polarized light. The rectilinear fabric was hypothesized to result from the three-dimensional stacking of 20-50 micron chalcedony spherules.

This rectilinear fabric was so prevalent in the Angmaat Formation that Gauvey started asking whether the fabric was common in microfossil-bearing cherts. She requested and received samples from Professor Emeritus Andrew Knoll at Harvard University—the foremost authority on Precambrian microfossils—that spanned both time and space. With the samples, Gauvey showed, first, that this rectilinear petrographic fabric is common to all microfossil-bearing cherts. She began, however, to also note that the preservation of the individual spherules varied.

Gauvey has since deciphered several distinct pathways of diagenesis, wherein chalcedony spherules (which consist of a three-dimensional array of micro-scale fibrous crystals) undergo various patterns of grain coarsening that incorporates similarly oriented fibers into single, larger crystals. The degree to which this grain coarsening occurs appears to reflect whether silica is permeating an originally organic or mineral matrix, as well as the degree of water-rock interaction.

Gauvey also has been exploring different techniques (XRD, SEM-EBSD, Raman spectroscopy, and FTIR spectroscopy) to further explore microfossiliferous cherts, and she has submitted her first manuscript on these fabrics.

ENVIRONMENTAL STUDIES MAJORS ANALYZE WATER AT DAIRY

EEPS students are putting their environmental studies to work monitoring groundwater quality at the UT dairy research unit in Blount County.

Ethan Parker, director of the East Tennessee AgResearch and Education Center – Little River Unit approached Lecturer Amy Robinson about the project. While the Walland, Tennessee, farm's primary research is on dairy production, it also provides a great outdoor classroom for multiple fields.

Robinson recruited undergraduates Maddie Hawkins and Kee-Lee Overbeck. Together, they collected and analyzed samples in fall 2024 as the first part of a project expected to help the dairy monitor the effects of updated management practices on water quality.

The farm separates solids and liquids from wastewater and applies the nutrients to crops. To make the process more efficient as the number of dairy cows in the facility has grown, UT plans to add a flocculant to help separate solids from the wastewater slurry. "They're really trying to be mindful of all the inputs into that system," Robinson explained. "They wanted us to come look at the groundwater before they start adding a change to their treatment process."

The data collected in fall 2024 will provide a baseline for ongoing monitoring during planned updates, all in service of supporting sustainable management practices in the dairy.

The students conducted the work as part of a semester-long EEPS independent study course where they learn strategies to constrain research questions, develop confidence with new analytical methods and data collection, and carefully manage their time to complete the work.

"These types of experiences are invaluable, especially when students get to better understand how their data can be used to inform treatment strategies and management practices," Robinson said.

"A lot of times when you're taking classes like hydrogeology, you're really learning calculations and the theory of how we describe groundwater flow rather than the composition of groundwater. These types of things are sort of compartmentalized," she said. "I like having a problem and then helping students learn how to think about it in three dimensions: What controls the groundwater flow? How does what it's flowing through impact the chemistry? How do management practices impact it?"

During a project like this, students have an opportunity to look at how groundwater flow and geochemistry might respond to natural and anthropogenic (manure) inputs across a broad area and over time. It is a great opportunity to conceptualize a problem, incorporate some of the complexities that are inherent to real-world applications, apply what they have learned in the classroom, and contribute to solutions in a limited time frame.

Hawkins and Overbeck visited the farm three times. They used a new YSI probe to determine temperature, nitrate, specific conductance, and pH onsite and completed additional geochemical analyses in the lab (e.g., phosphate, lignin and tannin, dissolved organic carbon). By comparing their data to previous data sets, they were able to better understand how the groundwater responded to inputs from the dairy processes, an important lesson for these environmental studies majors who want to learn tools to help manage our resources.

(Left) UT students Maddie Hawkins and Kee-Lee Overbeck collect groundwater samples at the East Tennessee AgResearch and Education Center – Little River Unit.

The EEPS Advisory Board allows students to connect with potential employers and see opportunities in the public and private sector with Geoscience Career Day.

ALUMNUS SPOTLIGHT

A LIFE IN GEOLOGY IS AN ADVENTURE

Dave Cantrell's career has allowed him to travel the world.

Dave Cantrell's original ambition in life was to be Indiana Jones. Rather than archeology, however, he chose geology, earning a bachelor's degree from UT in 1979, followed by a master's degree in 1982. His choice still allowed him to work in and travel to interesting and exotic locations, plus he contributed to developing a better understanding of some of the world's most significant hydrocarbon accumulations.

Cantrell discovered what he calls the "joy of carbonates" while pursuing his master's degree under Ken Walker. "The pursuit of these most interesting of rocks and sediments has in many ways guided my steps and shaped my career for the next 35 years," Cantrell said.

He started as a research and production geologist at Exxon, where he conducted reservoir characterization and geological modeling studies on reservoirs in the Middle East; the Permian, Powder River, Williston, and Gulf of Mexico Basins of the USA; and the Maracaibo and Barinas Basins of Venezuela—among others.

After 15 years with Exxon, he accepted a position with the Saudi Arabian Oil Company (Aramco), and lived in Saudi Arabia for the next 20 years. There, he studied several large carbonate fields (including the Ghawar field, the largest oil field in the world), and led geologic research and development for Aramco for eight years.

During this time, he also completed a PhD at the University of Manchester in England. Toward the end of his time with Aramco, he also served as a professor and associate director for a new college sponsored by Saudi Aramco, the College of Petroleum Engineering and Geosciences at King Fahd University of Petroleum and Minerals. There, Cantrell discovered that he enjoyed working with and mentoring young people in the art and science of geological reservoir characterization, modeling, and reservoir quality prediction.

After officially retiring in mid-2017, he returned to Tennessee and started a small consulting company. Cantrell also began a tenure as an adjunct professor at Stanford University, as well as engagements as part of the UT Alumni Board and as a citizen scientist with a number of nonprofits.

Even in retirement, his adventure continues.

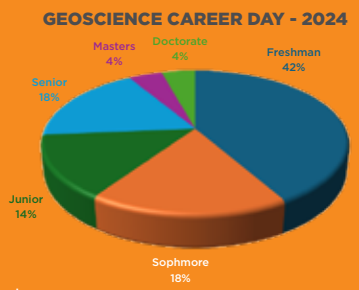
EEPS ADVISORY BOARD EFFORTS INVEST IN FUTURE

By Ashley Ramsey

Consider joining the advisory board here

The EEPS Advisory Board held its first VOLstarter fundraiser in conjunction with the Big Orange Give, raising nearly $9,000 through generous community support. The funds will support the department's critical needs such as conference attendance, field courses, emergency financial assistance, and much more.

The board also has prepared for the third annual Geoscience Career Day is planned for Feb. 24 in Strong Hall. It's a chance for students to connect with industry professionals in the public and private sector, learn about career opportunities, and discover internships and job openings.



Thank you for your continued support and involvement with the EEPS department. If you are passionate about shaping the future of geoscience education and want to make a tangible impact, consider joining the advisory board. By becoming a member, you can leverage your expertise, network with fellow professionals, and directly contribute to the success of our students and programs. Please complete the interest form to get involved: **eeps.utk.edu/about/alumni-update-form**.

THE UNIVERSITY OF TENNESSEE KNOXVILLE
COLLEGE OF ARTS & SCIENCES

DEPARTMENT OF EARTH, ENVIRONMENTAL & PLANETARY SCIENCES

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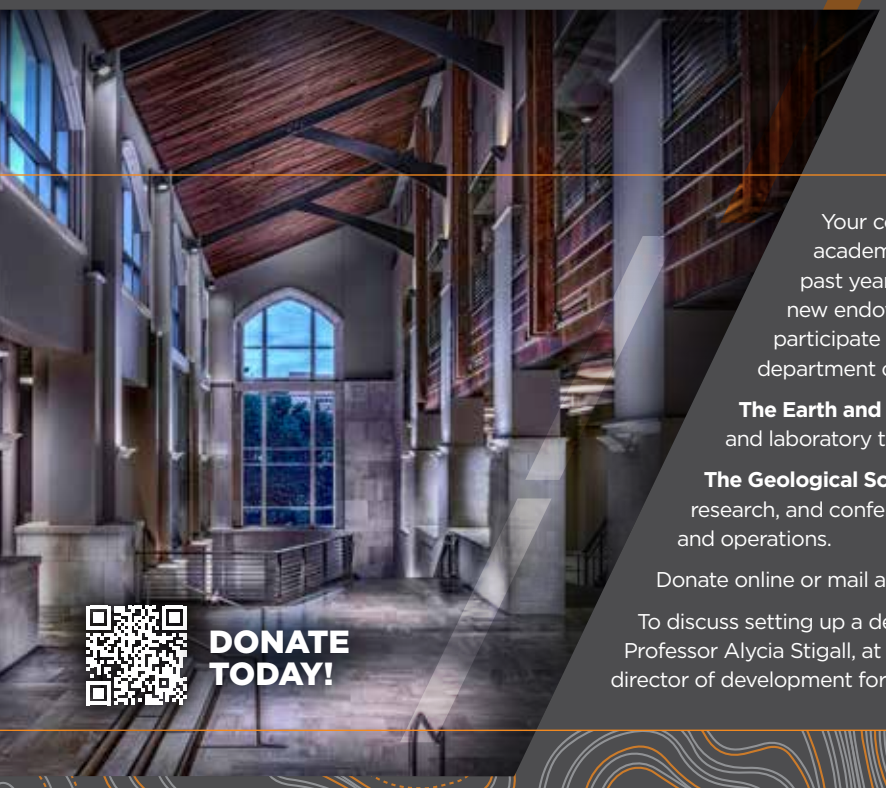

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GIVING OPPORTUNITIES

Your contributions, no matter the size, play a critical role in supporting academic achievement and research by students and faculty. Over the past year gifts have provided graduate student fellowships, created two new endowed professorships, and helped to offset the costs for students to participate in the new field courses. It is through your support that we are a department on the rise.

The Earth and Planetary Sciences Enrichment Fund supports initiatives from field and laboratory training to research expenses.

The Geological Sciences Honor Endowment provides resources for field trips, research, and conference travel for our students and supports research opportunities and operations.

Donate online or mail a check payable to the UT Foundation to the EEPS address above.

To discuss setting up a departmental endowment, major gift, or bequest please contact Professor Alycia Stigall, at stigall@utk.edu or 865-974-5499 or Elizabeth Weatherly, executive director of development for the college, at eweatherly@utfi.org or 865-974-8352.

Terra Firma

NEWSLETTER
SPRING 2025