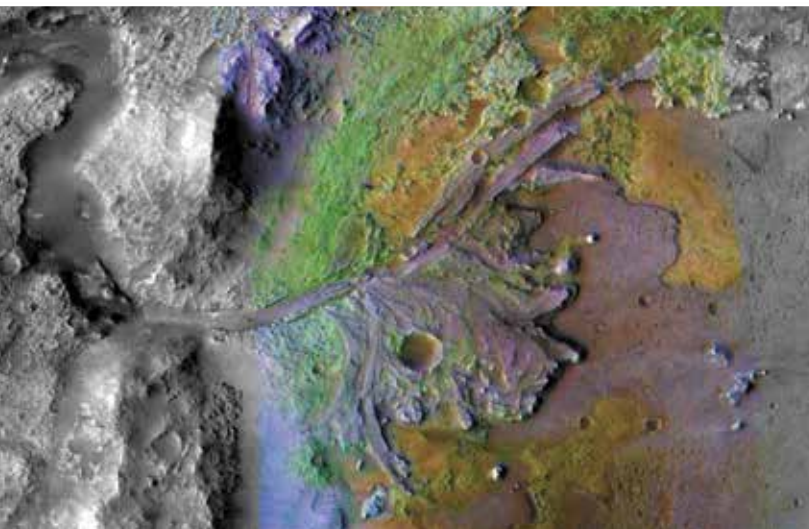


# Terra Firma

FALL 2019 NEWSLETTER

## Mapping Mars

Sometimes an opportunity comes along that is too good to miss. In early summer 2019, EPS Professor Linda Kah was asked by NASA's Mars 2020 mission to serve as one of a small handful of team scientists leading the charge to create a 1:5000 scale map of the proposed landing site, Jezero crater. After spending the summer defining map units and working with more than 60 different scientists mapping the region, there was still a lot to be done, so Linda asked a bit of an unusual question: Could the University of Tennessee add six undergraduate students to the science team and have these students take a course on surficial mapping that would involve working on a large number of currently unmapped quadrangles? She could not have been more pleased when the mission agreed!



Jezero crater, the landing site for the Mars 2020 rover, is thought to have once housed a large lake. Orbital images show the presence of fluvial and deltaic deposits, and spectral signatures indicate the presence of smectite clay in the delta (blue-purple), magnesian carbonate in shoreline environments (green), and abundant olivine partially exposed crater floor material (orange).

The Mars 2020 mission—which launches in June 2020—is NASA's next flagship mission to Mars, and the first leg of an ambitious series of missions focused on sample return. While on the surface, the Mars 2020 rover will explore signs of ancient environments with conditions that might have been favorable to microbial life and seek out preserved biosignatures in rock samples. The Mars 2020 mission will also demonstrate key

technologies designed to monitor environmental conditions and to use natural resources on Mars for life support and fuel for future human explorers.

Jezero crater has great potential as a landing site. The presence of multiple inflow channels associated deltaic deposits and a single prominent outflow channel suggest the potential for the persistent presence of water, and the presence of numerous mineralogical signatures that range from mafic, olivine, and pyroxene bearing assemblages to potentially sedimentary carbonate and clay minerals provide ample targets for investigation. Developing our best understanding of the landing site, and identifying potential targets for investigation, is therefore a critical element of mission preparation.

Undergraduates William Atkins, Brandon Boring, Taryn Hicks, Noah Miklusicak, Emily Shaver, and Russell Spaulding are currently hard at work, with additional guidance being provided by PhD student Keenan Golder and former student master's student Rose Bordon ('18). What a wonderful opportunity for our students to play a direct role in a process that will impact a flagship mission to Mars!

Linda Kah (front left) and UT students with the results of their mapping efforts. Together, the class mapped more than 30 1.-km squared quadrangles.



### what's inside:

page 2 Message from Department Head  
 page 3 New ICP-MS Core Research Facility  
 page 4 Faculty News

page 5 Department News  
 page 6 Advisory Board News  
 page 7 Alumni News



**MIKE MCKINNEY**

Department Head  
Earth & Planetary Sciences

## A Changing Landscape

Greetings from the Department of Earth and Planetary Sciences! I hope this letter finds you well. As usual, we've had many changes since my letter to you last year. Josh Emery and Devon Burr have departed for their new home at Northern Arizona University. Larry McKay has moved over to the College of Arts and Sciences administration where he is now associate dean for research and facilities. Drew Steen has moved 60 percent of his position into the Department of Microbiology.

We have also gained some new faces. Jake Benner is a senior lecturer who came to us from Tufts University during summer of 2018. He not only teaches some introductory courses, but he serves as the coordinator for all of our 100-level labs (a big job indeed). Stephen Romaniello joins us as an associate professor. He will be assembling and managing our new state-of-the-art ICP-MS lab facility in Strong Hall. Steve has a very wide variety of research interests, and we expect him to be collaborating on many exciting projects. Our third new addition is Estifanos Haile who is a teaching post-doc with expertise in hydrogeology. He will be taking over some of Larry McKay's teaching duties, as well as creating a new course for our environmental studies curriculum.

Our wonderful alumni board continues to grow in members and also in the contributions of time and money given to EPS. We've never had a more active board. They have made a big difference in the lives of our students not only through monetary support, but also with a new career mentoring program that has generated huge interest among our undergraduate and graduate students.

As always, please stay in touch. We really enjoy staying connected with our graduates, recent or otherwise. Please drop me, or your former mentors or professors, an email.

All the best,  
**Mike McKinney**



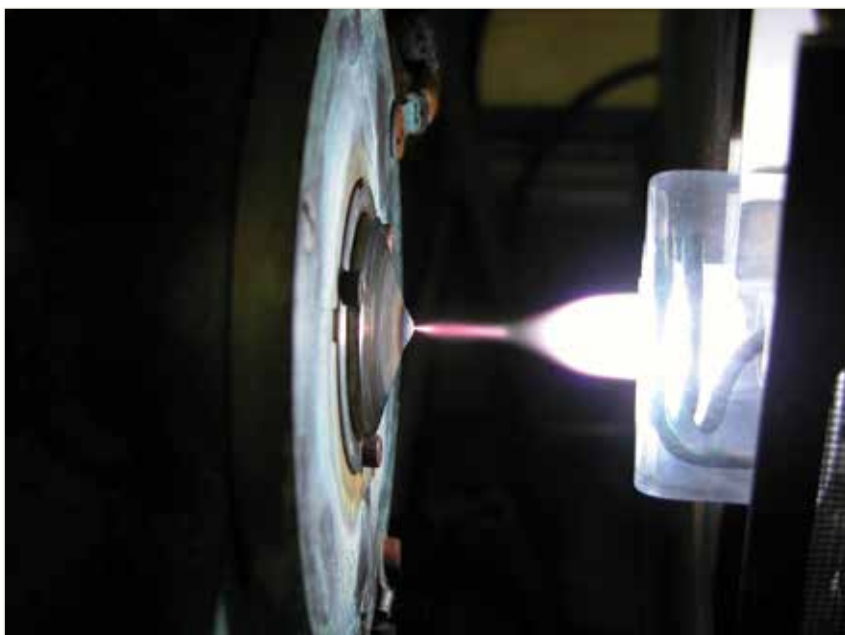
To read more news from EPS, please visit us online at [eps.utk.edu](http://eps.utk.edu).

# EPS Anticipates New ICP-MS Core Research Facility

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With the arrival of our newest faculty member, Assistant Professor Stephen Romaniello, members of EPS eagerly look forward to the establishment of a new Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) Core Facility. The new facility will provide high-precision geochronology, as well as concentration and isotopic analyses of solid and liquid samples to meet the needs of EPS faculty and other scientists across the UT campus.

Planned and developed in coordination with UT's Office of Research and Engagement and College of Arts of Sciences, the new facility will feature two new state-of-the-art Q-ICP-MS and MC-ICP-MS mass spectrometers and provide both traditional solution-based analyses along with laser ablation capabilities for *in situ* microanalysis of solid samples. The facility will also include a new 900-square-foot metal-free geochemical clean room for the preparation of contamination-sensitive samples for analysis.



Examples of EPS research that will make use of the new facility include U-Pb dating of detrital zircons for sedimentary provenance, Si isotope measurements in ancient cherts, *in situ* rare earth element profiles in individual mineral grains, major and trace element concentrations in surface and groundwater studies, and trace element and uranium isotope analyses in ancient carbonate sediments spanning mass extinction and ocean anoxic events.

One of the most unusual projects planned for the new ICP-MS Facility is measurement of calcium isotope variations in the blood and urine of astronauts living aboard the International Space Station (ISS). When astronauts live in zero-gravity for extended periods of time, they experience significant bone loss because their bones do not have to work against the force of gravity. An astronaut living aboard the ISS can experience up to one percent bone loss

per month – about the same as a person with osteoporosis might lose in a whole year. In order to better understand the trajectory of bone loss during space flight, Romaniello received a seven-year-long NASA-funded grant to study bone loss in astronauts living aboard the ISS for up to 12 months. Calcium isotopes turn out to be one of the most sensitive and quantitative ways of measuring bone loss during space flight. This project is an essential step on the road to crewed exploration of Mars, which will require astronauts to spend 16-24 months in space.

Because the ICP-MS Core Facility will be open to researchers across and outside of UT, it provides an exciting new opportunity to engage in interdisciplinary collaborations with researchers located at Oak Ridge National Laboratory, UT Departments of Biology, Chemistry, and Anthropology, and the Colleges of Agriculture, Engineering, and Veterinary Medicine. EPS looks forward to the new ICP-MS Core Facility as a cornerstone of our expanded research capabilities.



**STEPHEN ROMANIELLO**

Gerald D. Sisk Associate Professor  
of Isotope Geochemistry

## New Faculty Spotlight

Stephen Romaniello, Gerald D. Sisk Associate Professor of Isotope Geochemistry, is the newest addition to the Department of Earth and Planetary Sciences. He will serve as the founding director of the new UT ICP-MS Core Research Facility located in 1,200-square-foot of newly renovated lab space on the seventh floor of Strong Hall. Prior to moving to UT, Romaniello helped manage the W.M. Keck Laboratory for Environmental Biogeochemistry and Isotope Cosmochemistry and Geochronology Laboratories at Arizona State University for more than seven years.

Romaniello has a decade of experience developing cutting edge applications of nontraditional stable and radiogenic isotopes in sedimentology, cosmochemistry, and medicine. The core of his research addresses how the Earth’s chemical and biological evolution has played out over the past 3.8 billion years—especially the link between oxygenation of Earth’s atmosphere and oceans and the evolution of microbes, plants, and animals that produce and respire oxygen.

“Metals are sensitive to oxygen. Everyone knows that metal will rust if exposed to oxygen and water,” Romaniello said. “We take advantage of this kind of chemistry, and the tiny isotopic fingerprints it leaves behind in the minerals precipitating on the seafloor through time, to understand how life on Earth has evolved through time.”

Romaniello is passionate about interdisciplinary research that connects modern field work, laboratory experiments, and geochemical modeling with the geologic record.

“This toolkit can be applied to problems in the geosciences, but we’ve also found ways to connect to biology, chemistry, materials science, and even medicine,” Romaniello said. “This allows us to bring together a large, dynamic group of undergraduate and graduate students, along with post-docs and faculty, to address a wide range of problems.”

## Graduate Student Spotlight: Exploring Tennessee’s Caves

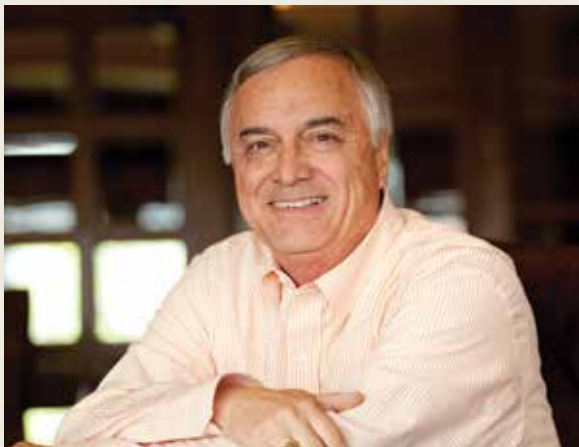
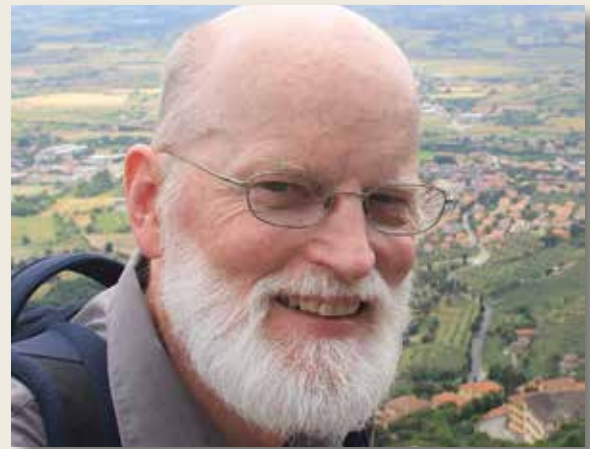
Tennessee, Alabama, and Georgia contain a huge number of caves and cave systems, but many of them remain understudied, both in terms of the organisms living in them and their general health of their associated ecosystems. In order to fill in the gaps of the region’s karstic environments, Annette Engel, professor of aqueous geochemistry and geomicrobiology, and members of her lab, have explored approximately 100 caves in the area. Now, one of her graduate students, PhD candidate Vickie Frazier, is turning her attention to the caves in the University of Tennessee’s own backyard – the caves of Knox County.

Of the 252 caves in and around Knoxville, 40 percent of them are situated in urban areas, which provided Frazier with the perfect case study to explore the effects of urbanization on cave stream ecosystems and water quality. She has been collecting water and sediment samples throughout the area, representing caves that are situated in the heart of city centers, those that sit in relatively undeveloped areas, and the full spectrum in between. She is specifically measuring the concentrations of nutrients and geochemical tracers associated with human development. Across the board, Frazier has found that proximity to urbanized areas has correlated with higher levels of nitrate, chloride, sulfate, potassium, and sodium concentrations in cave systems. These results differ based on how the surrounding land is being used; major highways do not generate the same results as residential areas. Also, while the measured concentrations do not meet the EPA threshold that might threaten human health, they are in the range that could potentially impact cave stream water quality and the organisms that live there, many of which are threatened or endangered.



# PLANETARY GEOSCIENCE

Harry Y. McSween, Jr. • Jeffrey E. Moersch  
 Devon M. Burr • William M. Dunne • Joshua P. Emery  
 Linda C. Kah • Molly C. McCanta



UT EPS faculty members Hap McSween, Jeff Moersch, Bill Dunne, Linda Kah, and Molly McCanta, along with recent faculty Devon Burr and Josh Emery, published a new textbook based on a popular planetary geoscience course taught in the department. It is the first textbook at the upper-division undergraduate level to approach planetary science from an explicitly process-oriented geological perspective.

# ADVISORY BOARD



EPS students and advisory board members engaging in career round-table discussion.

Members of the Department of Earth & Planetary Sciences Advisory Board had a busy and productive year. The board grew to 27 members who continue to provide scholarship funds to students. The plan is to implement a student-mentoring program in the near future.

The spring 2019 board meeting took place June 7 in Strong Hall. Department Head Mike McKinney reported that approximately \$9,000 in advisory board scholarship funds were awarded to 16 students last spring in two categories – general scholarships and financial need/hardship scholarships – all of which are funded by contributions from our board members.

Improving involvement with EPS students is a huge focus for members of the board. At both the fall 2018 and spring 2019 meetings, several students presented talks on their areas of research. It was a great forum for board members and students to get to know each other better and for board members to become familiar with student research areas.

At the June meeting, students engaged in a roundtable discussion with board members on career possibilities and, in turn, board members shared their career journeys. It was well-attended and the discussion was productive. Students Jake Alexander and Kristan Watkins gave an update on student clubs. They shared that many students are interested in connecting with an EPS alumni mentor, which McKinney and board members are working to make a reality.

The advisory board also has an active awards committee. Members of the committee and EPS department recognize alumni who had significant success in their professional careers and who have contributed time and resources to EPS. During the past year, members recognized Ron Tisdale ('74) for his long history of support of the department and outgoing EPS department head Larry McKay for his productive tenure and support in helping to rejuvenate the advisory board.

We are always interested in suggestions on how the advisory board can better support the department and students. If you have any ideas that you want to share, please send them to the department. We are also always looking for more members, so give a shout if you are interested in serving on the board – there are a few vacant positions and we will probably have some members rotating out shortly.

Learn more about our members at [eps.utk.edu](https://eps.utk.edu).



TW Garrett ('73) and his wife, Claire, hosted approximately 25 EPS students, faculty, and staff at the Salamander's Ball at the Knoxville Zoo October 5. The event is a fundraiser for Discover Life in America, a nonprofit dedicated to biodiversity and species preservation in Great Smoky Mountains National Park.

TW and Claire are strongly committed to several conservation organizations, including the Rocky Mountain Elk Foundation. They were delighted to have such a good faculty and student turnout at the Salamander's Ball and especially enjoyed meeting with Tyler Grambling, a doctoral student and the 2018 recipient of the Garrett Graduate Fellowship.



**DEPARTMENT OF EARTH  
& PLANETARY SCIENCES**

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## GIVING OPPORTUNITIES

Please consider a gift in memory  
of two great faculty members

### **DON BYERLY FIELD CAMP FUND**

This endowment, established by Don and Sue Byerly in 1997, provides support for undergraduates attending field camp. It is based on financial need and is particularly important for first generation geology students.

### **LAWRENCE A. TAYLOR GRADUATE FELLOWSHIP FUND**

This endowment, established last summer by Dawn Taylor in memory of her husband, provides two PhD fellowships each year. Students in all fields of geology can be considered for a fellowship, with preference that at least one award each year be given to a female student.

If you would like more information about any of these funds or would like to discuss a major gift or bequest, please contact Professor Michael McKinney, at [mmckinne@utk.edu](mailto:mmckinne@utk.edu) or 865-974-5499 or Deloris Mabins, college development, at [dmabinsa@utk.edu](mailto:dmabinsa@utk.edu) or 865-974-3816. Donations can be mailed to EPS, with check payable to the UT Foundation, or can be made online at [eps.utk.edu](https://eps.utk.edu) under the heading of **"Give to Earth and Planetary Sciences."**

**Your gift counts more than ever!**

*Your contributions, no matter what size, play a critical role in supporting academic achievement and research by students and faculty.*

# Terra Firma

FALL 2019 EARTH & PLANETARY SCIENCES NEWSLETTER