

Terra Firma

FALL 2018 NEWSLETTER

STUDENT SPOTLIGHT



Set in Stone

Seth Wood ('18) changed his major three times during his first two years as an undergraduate student at UT. He discovered his passion, however, when he embarked on a cross-country road trip to Taos, New Mexico, at the end of his sophomore year.

"It seemed like nothing could hold my interest those first two years," Wood says. "My academic trajectory took an unexpected turn when I found myself mesmerized by the variety of landscapes I saw on my road trip across the country and began researching the geological history of the places I visited. Before I knew it, I was hooked. Who knew rocks could tell such interesting stories?"

When he returned to campus before the 2015-16 academic year started, Wood met with Colin Sumrall, associate professor in the Department of Earth and Planetary Sciences, and changed his major for the fourth and final time. Wood began his junior year at UT as a geology major.

"My transition to a STEM field began slowly," Wood says. "I was stuck taking a seemingly endless series of prerequisites courses, but in the 2016 spring semester, I took my first upper-level geology course, Earth Sedimentary Processes, with Professor Linda C. Kah. This course both vindicated my decision to change majors and showed me that geology is both a science and an art."

Wood completed the course and immediately started working with Kah and her former graduate student on a new methodology for assessing the taphonomic preservation of cyanobacteria in 1.1 Ga chert using high-resolution imagery.

"We needed to one, identify assessments locations in a statistically-randomly manner, two, classify microfossils on the bases of morphology and preservation state, and three, record the spatial location of assessed microfossils," Wood says. "Like most research projects, there were a plethora of failures, but,

in the end, we succeeded in developing a new sampling methodology, and I got to present our findings at a regional GSA conference and UT's Exhibition of Undergraduate Research and Creative Achievement, both in 2017."

The following summer, Wood began a ten-week internship at Oak Ridge National Lab through the Science Undergraduate Laboratory Internships program. He researched the presence and spatial distribution of vaterite, an enigmatic calcium carbonate polymorph, in the earbones of some fish using micro-Raman spectroscopy, powder X-ray diffraction, and X-ray fluorescence.

Next, Wood enrolled in ORNL's Higher Education Research Program. He began researching the formation of biogenic vaterite and its distribution coefficients using single-crystal



X-ray diffraction, inductively coupled plasma mass spectrometry (ICP-MS), and neutron diffraction.

"My research at ORNL is ongoing, but I have presented preliminary findings in 2017 at ORNL's research symposium and the

annual GSA conference in Seattle; and in 2018 at the regional GSA conference in Knoxville and EURECA."

Wood also worked with Molly McCanta, associate professor in EPS, to elucidate the eruptive history of Montserrat by assessing the trace element composition of volcanic glasses in minor-ash beds, termed cryptotephra, deposited ~800 meters below sea level. They conducted geochemical assessments using UT's Cameca SX100 electron microprobe and presented their findings at a regional GSA conference in 2018.

"I want to thank the EPS faculty and staff for their support," Wood says. "Special thanks to Dr. Linda C. Kah and Dr. Molly McCanta for their guidance – you have played an integral role in shaping me into the researcher that I am and the scientist I strive to be."

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MIKE MCKINNEY
Department Head
Earth & Planetary Sciences

Settling into Strong, GSA Success, and more from EPS

Greetings from the Department of Earth and Planetary Sciences! I hope this letter finds you doing well. Here at EPS we are continuing our transition into Strong Hall, which is beginning to feel more like home. We have a new “aesthetics” committee (chaired by Linda Kah), which aims to transform our austere bare walls into something more attractive. Labs are becoming filled and functional, and students are enjoying the benefits of modernized equipment and facilities.

Our EPS family is continuing to grow. We received permission to hire a new faculty member who specializes in the use of inductively coupled plasma mass spectrometry (ICP-MS). We were very happy to get this approved as this equipment has a huge diversity of uses and will be a big boost to many kinds of research, in many disciplines. Although Bob Hatcher officially retired last year, he will continue working on several research projects.

On a sad note, Don Byerly passed away in April at the age of 85. I’m sure many of you will remember Don not only because he was active for so many years, but for his legendary cheerfulness. Of course, he was also well known for his work with field camp and knowledge of our local geology.



Also notable last year was the great success of Southeastern GSA we hosted. Thanks to Colin Sumrall and many others, we had the second largest attendance in the meeting’s history. In addition to many high-

quality presentations and discussions, we were able to visit with many alumni and old friends, including a reception in Strong Hall.

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.

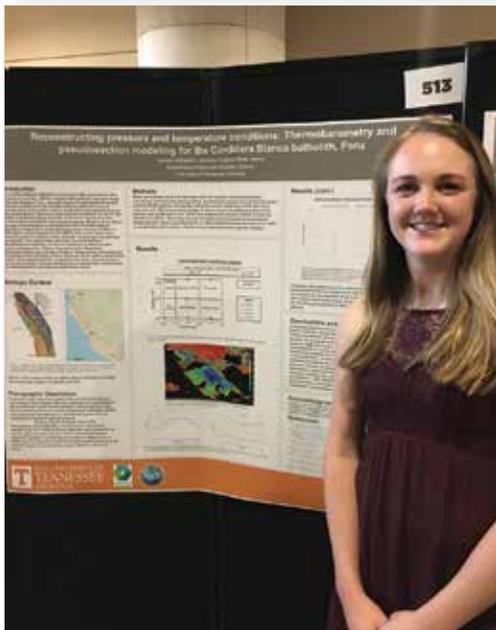
All the best,
Mike McKinney



To read more news from EPS, please visit us online at eps.utk.edu.



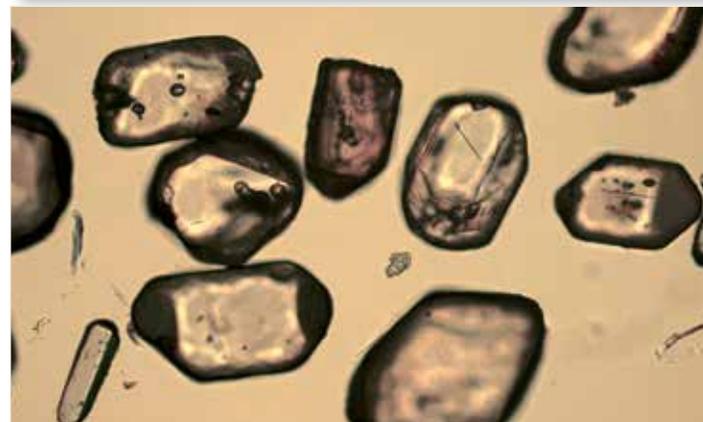
Studying Emplacement Histories in Peru



Hannah Teffeteller is a first-year master's student who recently completed her bachelor's degree in geology from UT. During her senior year, she participated in undergraduate research with Micah Jessup, associate professor, and graduate student Cameron Hughes. Her research objective is to better constrain emplacement pressure and temperature conditions for the Cordillera Blanca batholith in Peru. Formation history of the Cordillera Blanca batholith is not well understood, but could be unraveled through a better understanding of past pressure and temperature conditions using methods such as Al-in-hornblende thermobarometry.

Emplacement pressure values for the batholith using Al-in-hornblende thermobarometry were previously published by a group who sampled the eastern part of the batholith. The sample Hannah studied was sampled from the western flank of the batholith, which happens to be bounded by the Cordillera Blanca normal fault and may have a significant impact on localized geochemistry within the batholith.

Hannah analyzed the amount of aluminum in the mineral hornblende from one of Professor Jessup's samples of the batholith using a Cameca SX100 electron microprobe. She was able to calculate a pressure value based on aluminum content and compare these pressure values to previously published values in hopes of better constraining past pressure conditions. In short, the pressures she calculated increased the possible range of emplacement pressures, indicating that hornblende geochemistry can vary greatly across different regions of the batholith and that other methods need to be considered to better constrain emplacement histories.



Origin of Sediments

Professor **CHRISTOPHER FEDO** and his students use field studies as a core base of knowledge to develop research into the origin of sediments and sedimentary rocks, and their subsequent alteration. This research touches on a broad array of topics exploring sedimentary systems on both Earth and Mars.

Fedo and his students investigate the production of clastic sediment and track its compositional changes using Holocene, first-cycle sediments from the Mojave Desert. They observe how the composition of stream sediments sitting directly on granodioritic bedrock compare, a system that is one of the simplest natural laboratories where sediments should match their provenance in an environment with essentially no chemical weathering. The story, however, is much more complicated in terms of interpreting geochemistry and detrital zircon geochronology. They have found that the effects of sorting, during even minimal transport, can be sufficient to impart important changes on composition. Application of this type of detailed work to Cambrian sandstones and subjacent paleosols has revealed further information about reading provenance.

On Mars, Fedo and his students are working to reconstruct what appears to be a lacustrine basin fed by fluvial and deltaic systems that filled Gale crater, based on superb compositional and image-based data provided by NASA's Curiosity Mars rover. Not only are they looking to reconstruct the environments and searching for evidence of sustained water on the Martian surface, but they are also attempting to build stratigraphic architecture and diagenetic history. In an unplanned turn of events, Fedo's research on Cambrian, pre-vegetated sedimentary systems has a surprising amount of parallelism. They are evaluating the details of a distal alluvial braidplain that transitions to a braid delta, not entirely unlike the subaerial components of the rocks in Gale crater.

Sediment composition may undergo significant changes after deposition and burial as a result of interactions with basinal and/or hydrothermal fluids. Fedo's group also investigates these changes in both sedimentary rocks and paleosols. One nearly inescapable aspect of Paleozoic and older stratigraphic units is the addition of potassium and geochemically related elements to the system, which causes changes easily mistaken for provenance signatures or effects of weathering. Detangling these effects are critical in deciphering the compositional story clastic sedimentary rocks.

Almost unto itself is Fedo's research on Archean rocks, which contains elements of virtually everything noted above, set in the context of an earth so foreign that few things, such as plate tectonics and continents, can be taken for granted. Adding in the nearly obligatory high degree of deformation and metamorphism provides the perfect recipe for challenging research. Fedo continues to look at rock samples collected 20 years ago, showing that well mapped and measured areas can yield science for a long time. One of the primary focus of research is the origin of iron rich rocks. While some turn out to be genuine chemical sedimentary rocks like chert and BIF, Fedo has also tracked incredible changes to volcanic rocks that add iron and silica and result in a rock that superficially resembles a sediment, but is the product of quite a turn of events.

» *Top:* Mudstone rip-up chips caught in the process of being made in the Cambrian Wood Canyon Formation, Mojave Desert.

» *Middle:* Detrital zircons from the Cambrian Wood Canyon Formation.

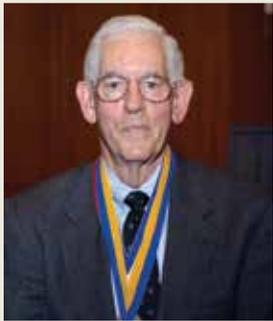
» *Bottom:* Rocks from the Abitibi Greenstone Belt, Canada, that are 2.7 billion years old. This hydrothermally altered rhyolite, is enriched in iron and silica.

Isotopes and Volcanoes

With new funding from NASA, **ANNA SZYNKIEWICZ**, assistant professor, and her research group continues field studies in terrestrial hydrothermal systems to understand sources and formation mechanisms of sulfate-bearing minerals on Mars. They use isotopes and metals as geochemical tracers to determine mechanisms of hydrogen sulfide oxidation to sulfate in acidic hot springs and mudpots. So far, they have travelled thousands of miles to collect water and sediment samples in Iceland, Lassen Volcano National Park in California, and Valles Caldera National Preserve in New Mexico. This fall, they are preparing for their last field campaign to Yellowstone National Park in Wyoming. Although all their field sites are very stinky because of elevated emission of hydrogen sulfide, they very much enjoy sample collection in beautiful landscapes of modern volcanoes.



Jessica Ende and Anna Szykiewicz sample the mud pot water for isotope analysis in Námafjall, Iceland.



Hatcher Retires, Leaves Legacy at UT

Bob Hatcher officially retired June 30, 2018, after 32 years at UT following six years at South

Carolina, two years at Florida State, 12 years at Clemson, and a year with Humble Oil and Refining Company (now ExxonMobil): a career spanning 53 years that began after receiving a PhD in geology from UT in 1965. During his career, Hatcher published more than 200 refereed scientific works, including nine books, along with many field guides and reports.

Hatcher considers himself a non-specialized field geologist who has made detailed geologic maps throughout his career and published papers integrating field data with data from other geoscience disciplines. His main goal in research has been to take the road less traveled and to make rocks talk and give up their secrets, leading to a better understanding of continental crust and mountain chains.

Hatcher is a Fellow of the Geological Society of America, American Association for the Advancement of Science, and Geological Association of Canada, and was president of GSA in 1993 and the American Geosciences Institute in 1996. He received the GSA Penrose (2006), AGI Campbell (2006), and AGI Milling (2014) Medals. The Penrose Medal is the highest award in geology. He also received the Eastern AAPG Outstanding Educator Award in 2011. He served as GSA *Bulletin* editor from 1982-88. He also has convened three GSA Penrose Conferences, presented testimony before United States Senate and House committees, and served on three Federal Advisory Committees. He was nominated for the National Medal of Science (1997).

Hatcher is most proud of the more than 50 outstanding students who have completed MS and 17 students who have completed PhD degrees with him. Today, they are employed in oil, mining, seismic hazard, and engineering/environmental companies, state geological surveys, the USGS, and academic positions across the United States.



Hatcher is forever grateful for the generous UT Science Alliance salary and stipend support as a Distinguished Scientist and professor for 32 years. He hopes that he has returned dividends that justify the level of support UT has provided.

For the future, Hatcher has no intentions of sitting in a rocking chair and watching grass grow. This fall he is teaching petroleum geology, reviewing page proofs for the third edition of his structural geology text, and writing several papers. In the long term, he intends to continue to work at his number one hobby—geology—by writing papers, doing some teaching and fieldwork, leading field trips, and maybe collecting another mountain chain. Other hobbies like writing, golf, and photography will also receive more attention.

EPS Alumni Honored for Professional Achievements

Two EPS alumni received awards during the annual College of Arts and Sciences Alumni Awards banquet Friday, September 21, 2018.

G. (Shan) Shanmugam ('78) received the Professional Achievement Award for his remarkable career, which included 22 years as a petroleum research geologist with Mobil Oil, followed by independent consulting and research, as well as teaching at University of Texas, Arlington. He has published extensively on deep-water sedimentology and has received many awards. Shan and his wife, Jean, attended the luncheon to receive this award and stayed afterwards to meet with students and give a talk on his recent research.

Peter K. Knappett ('10) received the Natural Sciences Achievement Award, which recognizes early- to mid-career alumni. Peter investigated factors controlling water quality in aquifers in Bangladesh for his dissertation. He then held post-doctoral appointments at the Helmholtz Center in Munich and at Lamont Doherty Earth Observatory of Columbia University. Peter is now an assistant professor at Texas A&M, where he has developed an impressive research and teaching program in hydrogeology. He received the GSA Hydrogeology Division's Kohut Early Career in 2014. Peter was unable to attend the award luncheon because his wife, Kelly, was expecting their first child.



Arts and Sciences Dean Theresa M. Lee presents Shanmugam with the professional achievement award.

EPS hosts the 67th Southeastern section meeting of the Geological Society of America

In mid-March, more than 800 professionals and undergraduate and graduate students attended the annual Southeastern Geological Society of America conference at UT. Several EPS faculty and students presented their research and chaired sessions. Highlights include a full-day symposium honoring the career of Professor Robert D. Hatcher Jr., undergraduate poster sessions with more than 80 presentations, and several well-attended field trips.

EPS also hosted a highly successful alumni reception in the atrium of Strong Hall with more than 50 alumni attending, in addition to numerous faculty members, students, and friends. Highlights of the evening included presentation of the Distinguished Alumnus Award to Robert J. Hatcher, Jr. ('65) and presentation of the Young Alumnus Award to Arthur Merschat ('03, '09), a former Hatcher student.

Professor Colin D. Sumrall chaired the conference with help from EPS faculty and students. Read his full report online at tiny.utk.edu/GSA.





In Memory of Don Byerly

Professor Emeritus Don Byerly (*photo, right*) passed away April 25, 2018, at the ripe old age of 85. Don was a UT academic product himself, having received both his MS and PhD degrees from the department. He began his career as a UT professor in 1966 and often consulted as a professional geologist. He was also very interested in teaching pre-college teachers about geology. In 2013 he published *The Last Billion Years: A Geologic History of Tennessee*.

Former geology students will remember his courses in engineering and environmental geology, and especially his geology field camps in Dayton. For many years, I was privileged to be part of that experience, and it was a great joy to see Don's infectious enthusiasm for East Tennessee geology and his true affection for the students. In later life, Don established the Byerly Field Camp Endowment, and handpicked the students who received scholarships, literally to the very end.

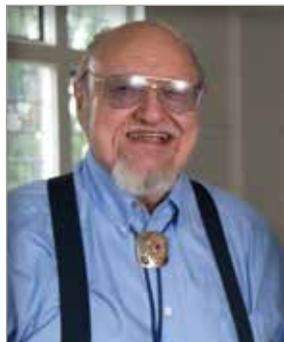
If anyone can be said to be a lifelong boy scout, it was Don. He always loved the outdoors, camping, trout fishing, and cooking breakfasts for large crowds. After his retirement, he continued to share his passion for geology by leading fieldtrips for many groups and giving impromptu lectures to anyone who would listen.

On reflection, I would have to say that Don was the nicest of my many colleagues in the department. He had a contagious, if ribald sense of humor, and never lost perspective on what really mattered. He often served as our department's corporate memory. Don was never a commanding researcher, but rather a talented practitioner of old fashioned field geology, and a teacher who understood how to reach students and non-scientists and share his enthusiasm for the natural world.

- HAP McSWEEN

A Tribute to the “Diamond” Ladies

The department recently received major gifts from two generous donors, who are linked by a love for the art and science of diamonds.



Dawn Taylor, widow of Professor **Larry Taylor**, made a gift to create two endowed PhD fellowships. The fellowships are in memory of Larry, who passed away last year. Larry founded the Planetary Geoscience program at UT and was a very successful researcher on the origin of diamonds on Earth. He published a book on Siberian diamonds and numerous journal articles on diamondiferous eclogites. Dawn and Larry Taylor made several other major gifts to the department, including the Larry A. Taylor Professorship and a gift to the Strong Hall fund.



Karen Sisk, widow of **Gerald “Jerry” D. Sisk** who passed away in 2013, made a gift of an endowment for two Gerald A. Sisk Professorships in mineralogy and petrology. Jerry and Karen were amongst the co-founders of Jewelry Television (JTV), a highly successful private company based in Knoxville. They were both UT graduates, Jerry in Spanish ('75) and Karen in math ('74). Jerry also apprenticed and received certification as a registered gemologist. He had a tremendous passion for the beauty, as well as the marketing, of gems and mineral specimens. Jerry published a popular *Guide to Gems & Jewelry*, as well as a three-volume opus, the *Sisk Gemology Reference*, which is notable for its exquisite photos of gems and collectible minerals.

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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 Larry McKay, at lmckay@utk.edu or 865-974-7782 or Deloris Mabins, college development, at 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 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

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