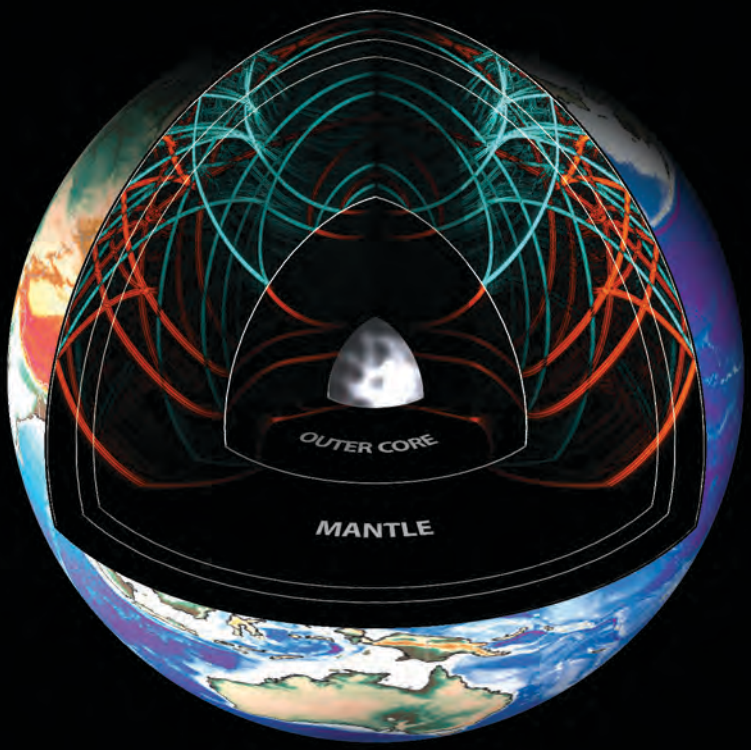
WHAT ON

SPRING 2018

EARTH

A PUBLICATION OF THE COLLEGE OF MINES & EARTH SCIENCES AT THE UNIVERSITY OF UTAH



NEW WAVES IN SEISMIC MODELING

Dear Colleagues and Friends of the College of Mines and Earth Sciences (CMES):

Drs. Darryl and Ann Butt joined the U in Fall 2016.

As many of you know, we were deeply saddened last fall by the passing of Dean Emeritus and Distinguished Professor Francis "Frank" Brown. Our deepest sympathies continue to go out to his family and friends, particularly his wonderful daughters and grandchildren whom Frank treasured above all things.

Frank was a legend on campus, known both for his intellect and for the very long hours that he worked. I always enjoyed stopping by Frank's office in the evening for advice and words of wisdom. Our conversations usually strayed. I recall talking to him about the meaning of patterns in Native American weavings, about the color of purple produced from murex, and about various predicaments he found himself in while traveling in Africa. The list goes on. Regardless of the importance or obscurity of the topic, Frank was always completely immersed in our conversations. He was immensely curious and had no biases that prevented him from understanding things deeply—he was, very simply, interested in everything. Frank set a high bar for all of us, as a teacher, a researcher, an administrator, and most importantly as a human being.

Though saddened by Frank's passing, we can take much consolation in the fact that Frank's legacy at the University of Utah is lasting and rich with lessons. Frank led by example. He was committed to liberal education and life-long learning, and was not bound by discipline or academic labels. While he was a world-class geologist, he was also a biologist, botanist, linguist, philosopher, theologian, philanthropist, and accomplished writer. He was loyal to a fault, generous, and cared deeply about the institution that he served. If there is one thing to take from Frank's life and distinguished career, it might be to live in the moment and be passionate about your work. Were he here now, he would certainly advise us to remember the past, but focus on the future.

To that end, you have in your hands, or on your computer screen, the first volume of a new CMES publication, entitled *What On EARTH?* While this bulletin is intended to inform you of news on topics such as faculty hires, alumni updates, awards, research, and educational happenings, a larger objective of this publication is to help you appreciate the breadth of the college and the many common threads that exist among our departments as well as with other colleges on campus.

What on EARTH? is organized to inform you about Education, Achievements, Research, Trends, and Happenings in CMES, hence the acronym EARTH. At least one section of each issue will highlight interdisciplinary strengths that cross the boundaries of all our departments. For example, as you will come to learn in this issue, faculty, staff, and students in all of our departments conduct world-class research that helps us understand, inform policy, and manage issues associated with a wide range of natural and anthropogenic hazards. We measure, model, and assess the structure and processes associated with phenomena such as avalanches, landslides, earthquakes, water quality, hurricane intensity, and atmospheric pollution; and we develop solutions to challenges associated with improving industrial safety, managing our nuclear waste, and detecting diseases as early as possible. So, as you peruse each issue, please pause and consider the various connections that bind us as a college.

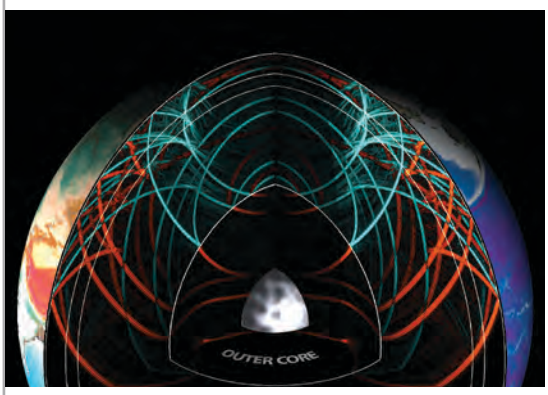
We also hope that *What On EARTH?* will serve to keep us connected with our alumni and friends. If you have news that you'd like to share with us, or just want to reconnect, please contact Development Director Travis "TJ" McMullin at travis.mcmullin@utah.edu or 801-581-4414. You can also connect with us through our college webpage.

Please stop by and say hello whenever you're in the neighborhood.

— Dr. Darryl P. Butt, Dean

CONTRIBUTORS

Darryl Butt
Paul Gabrielsen
Mahala Kephart
Travis McMullin
Lisa Potter
Anita Austin Tromp
Peter Veals
Kylie Boyce



Cover Image: Researchers use models like this simulation of earthquake-generated seismic waves to compare simulated wave propagation with actual records of ground motion. University of Utah seismologist Michael Thorne used seismic modeling to discover a large ultra-low velocity seismic zone near the core-mantle boundary beneath the Samoan Islands. His work is part of the wide diversity of seismic research happening at the College of Mines and Earth Sciences, home to the University of Utah Seismographic Stations network.

Science OR Fiction

GEOLOGY PROFESSOR EXPLORES THE ACCURACY OF HOLLYWOOD'S STORYTELLING

by Paul Gabrielsen

Photo by Dave Titensor

In the introductory geology course Natural Disasters, Gabriel Bowen, professor in the Department of Geology and Geophysics, explores a variety of important earth sciences principles using Hollywood blockbusters as a teaching tool. "The idea is to use film as a vehicle to get students interested in and excited about science – film provides something visual that they'll easily remember and relate to," says Bowen.

Students in this introductory geology class come from a variety of scientific backgrounds. During the semester, Bowen provides a guided exploration of important principles in the earth sciences, with a film screening each week that highlights that principle for them. For example, discussion of the Earth's interior is tied to the film *The Core*, while discussion of climate change follows a screening of *The Day After Tomorrow*. The week devoted to discussion of dinosaurs? It's tied to a viewing of *Jurassic Park*.

> *"The idea is to use Hollywood films as a vehicle to get students interested and excited about science."*

"We work through a broad suite of themes in the earth sciences," says Bowen. "And earth science affects us in many ways. I want students to have exposure to what an earth scientist does, why this discipline matters, and why the earth sciences might be important in their lives." Exploring these themes while also assessing and debating the relationship between Hollywood storytelling and established, peer-reviewed scientific principles has other benefits says Bowen. "There's a lot of nonsense and disinformation out there and making sense of it is something that any citizen needs to be able to do at some level."

Greenland Science, as Told to Greenland's Children

Elementary school in Kangerlussuaq, Greenland.

Photo by Olivia Miller

Dr. Olivia Miller, a 2017 doctoral graduate in geology and geophysics, and University of Utah STEM Ambassador, can add another title to her professional profile: children's book author.

In her role as STEM Ambassador for the university, Miller worked not only on her doctoral research project in Greenland (see story on p.10), but found a way to introduce local schoolchildren to that research in the form of a photo-rich storybook titled *Adventures on the Greenland Ice Sheet*.

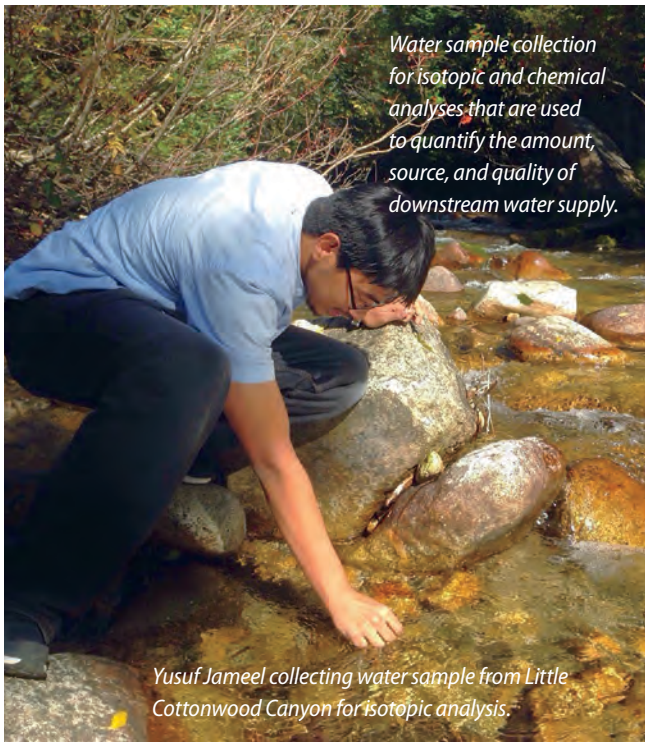
While the residents of the small East Greenlandic village of Kulusuk have grown accustomed to the seasonal presence of research teams from around the world, Miller realized there was an opening to help village schoolchildren put the work of those international researchers in context with their own lives and observations about their surroundings. With the help of a local schoolteacher, the story was translated into both the Danish and Greenlandic languages. Now housed in the village library (which is located in the village school) the book is available to schoolchildren and villagers alike.

For Miller, the book is significant because of the ways in which it ensures that her research reaches beyond her peers to those who will most directly be affected by changes in the ice sheet: the children of Greenland. "I do science to contribute to society," Miller says, "and sharing my work is part of that."

Interdisciplinary Graduate Certificate in Hydrology and Water Resources

While water is directly or indirectly involved in most, if not all, aspects of sustainability, science and engineering students are not routinely exposed to rapid advancements in related fields. The new Graduate Certificate in Hydrology and Water Resources addresses this issue as well as the need for an applied discipline with a focused curriculum. This curriculum integrates offerings from six university departments, including two from the College of Mines and Earth Sciences, (the Departments of Atmospheric Sciences and of Geology and Geophysics) and is a collaboration between the Graduate School, the Sustainability Office, and the Global Change and Sustainability Center. The hydrology certificate program will prepare students to become leaders in research and applications related to water resources, and will serve both graduate students and non-matriculated professionals working in the state and region. The certificate program is also designed to complement and enhance existing programs at the University of Utah and also meets the educational requirements for certification as a professional hydrologist by the American Institute of Hydrology.

Additional information can be found at *https://environment.utah.edu/hydro-certificate/*



Water sample collection for isotopic and chemical analyses that are used to quantify the amount, source, and quality of downstream water supply.

Yusuf Jameel collecting water sample from Little Cottonwood Canyon for isotopic analysis.

Photo by Samantha Weintraub

Laboratory Education at the Roger and Dawn Crus Center

Located in the William C. Browning Building, the Crus Center for Renewable Energy serves as a hub for applied research projects as well as activities designed to help educate the general public and encourage K-12 students to study science and engineering-related disciplines focusing on health, sustainability and renewable energy.

Roger and Dawn Crus, generous friends of the Department of Metallurgical Engineering, are providing financial support for efforts related to renewable energy; clean air and water; food quality and safety; resource sustainability via recycling, renewing and repurposing; early detection of preventable diseases; and new, improved or innovative treatments for preventable diseases. Ideally, research projects conducted at the Crus Center will lead to the development of commercially viable products that will benefit people living in Utah communities and throughout the world.

Recent examples of undergraduate research conducted at the Crus Center include:

Alec Mittelstadt (mentored by Dr. Krista Carlson) has worked on air purification, water filtration, and nanotube synthesis projects. His most recent research has been focused on improving efficiency and reducing the amount of waste produced in research laboratories.

Alec Mittelstadt

Dr. Pankaj Kumar and Olivia Pratt

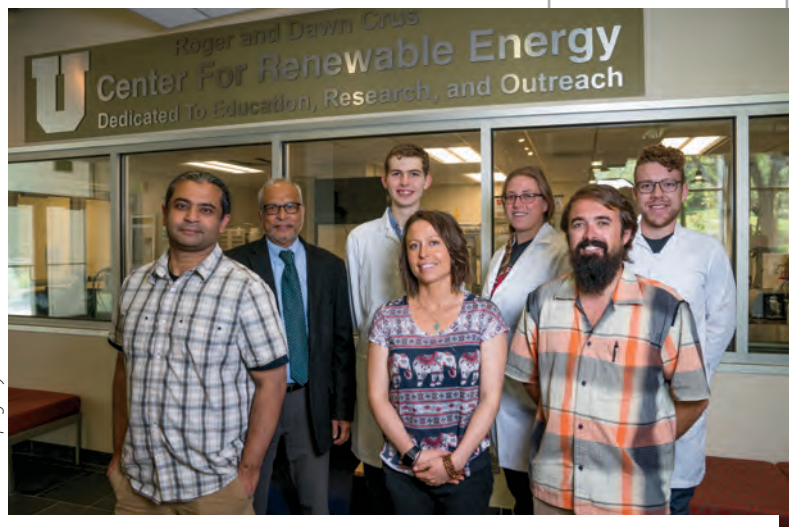
Ashley Timmerman

Ashley Timmerman (mentored by Dr. Swomitra Mohanty) is researching techniques for the detection of pharmaceuticals, such as ibuprofen and triclosan, in our water supply. Her research could lead to cleaner drinking water and prevention of disease.

Alexander Reifsnyder (mentored by Dr. Krista Carlson) seeks to create a high-efficiency filter mechanism to safely and efficiently capture the dangerous volatile radionuclides released during nuclear waste processing to prevent them from being released into the atmosphere.

Olivia Pratt (mentored by Dr. Manoranjan Misra & Dr. Pankaj Kumar) is focused on developing sensors for detecting the bacterial and fungal contamination of food. Use of these sensors could help prevent contamination related illness and loss of life, benefitting people throughout the world.

Tanner Livingston (mentored by Dr. York Smith) has been investigating methods to recover and recycle valuable metals and rare earth minerals from end-of-life solar panels and lithium ion batteries. The technology he is investigating has the potential for reducing or eliminating water and solvents currently used in recycling processes, thereby reducing both costs and environmental impacts.



Front row: Swomitra Mohanty, Krista Carlson, and York Smith (faculty in the Department of Metallurgical Engineering); Back row: Manoranjan Misra (department chair), and students Alexander Reifsnyder, Ashley Timmerman, and Alec Mittelstadt

Alexander Reifsnyder

Photos this page by Dave Titensor

International Student Experiences

SOUTH AFRICA

Dr. Cari Johnson from the Department of Geology and Geophysics spent two weeks with 12 undergraduate and graduate students on a field trip to the Karoo Basin of South Africa. The group focused much of their trip on turbidite fans, but the area is also known for its broad and continuous outcrop exposure in every direction, allowing for a variety of research and discussion opportunities. Tubidites are generally deep ocean geologic deposits that are formed by density or gravity flow. The Karoo Basin is an excellent place to observe these formations on a grand scale. "To stand in one place and view the deposits of the basin floor and the shoreline in a single vista is what makes the Karoo world-class, and aided us in understanding the entire depositional system as a whole," said Alex Koch.

PERÚ

The Education and Training Committee of the Society of Economic Geologists offered a four-day field course in the Yanacocha District of northern Perú. Participants observed core from the Yanacocha Sur deposit, spent several days in the field noting the alteration mineralogy and structural styles of key outcrops, and observed structural and alteration from several open pit mines that characterize the district. Dr. Erich Petersen along with students from the Department of Geology and Geophysics participated in the course that was offered in both English and Spanish. The course was suggested by Dale Finn, Newmont Regional Group Executive (South America Exploration), who supported the idea of a mapping-oriented course directed at professionals who would benefit from knowing "what to map, and why."

ECUADOR

Dr. William Johnson and 11 undergraduate students from the Department of Geology and Geophysics worked with five professors from Ecuadorian universities to investigate environmental concerns throughout Ecuador and across physical and social science perspectives. Emphasis was placed on sampling and post-trip analyses in four physical science contexts including sediment core retrieval, investigation of viability of lateral channel construction for remediation of mining-impacted rivers, water resource management, and trawl sampling for plastic microbeads. Social science activities examined community structure impacts on socio-economic concerns including indigenous perspectives. Students prepared for the trip by attending guest lectures and workshops and the course culminated in a report and presentation by the participants.


Photo by Anna Peterson


Photo by Jackson Vilchez


Photo by Clement Miege

JAPAN

A group of six students led by Dr. Mark Koopman, a research professor in metallurgical engineering and Minami Maggard, an interpreter from International and Area Studies, embarked on a study abroad class in Japan. They visited the largest bronze Buddha sculpture in the world in Nara, a sustainable farm in the mountains northwest of Kyoto, and a culinary knife forging company in Sakai. Four students participated from metallurgical engineering: Travis Wilhard, Silvia Padilla, Jaclyn Ray and Ellie Richardson, as well as Kyle Spaulding from mining engineering and Matt Browning from civil engineering. Each student undertook an independent study on a topic of their choice, comparing some aspect of technology between Japan and the USA. The students learned how to navigate, both physically and culturally, through various cities in Japan. A second offering of this class is planned for May 2018.

GREENLAND

Kip Solomon, professor of geology and geophysics, along with doctoral student Olivia Miller and other University of Utah researchers carried out fieldwork and study of Greenland's vast ice sheet under sponsorship of the National Science Foundation. The group drilled holes at intervals in the ice sheet and injected colored dyes to observe the location and connectivity of liquid water and its movement within the ice sheet. While their research is summarized in Miller's recent doctoral dissertation, you can read about their questions and findings in the Greenland-related stories on pages 3 and 10.

Photo by Dave Titensor

Nature Publication on Gender Bias

Jory Lerback, master's student in geology, along with Brooks Hansen, director of publications at the American Geophysical Union were published in *Nature International Journal of Science*. In their paper, they presented an analysis of gender bias in peer reviewers across all of the American-Geophysical Union-published journals. Only a few months following its publication, the paper has already been cited six times in peer-reviewed literature.

Outstanding Undergraduate Research Award

Nicholas Thiros received the 2017 Outstanding Undergraduate Researcher Award from the University of Utah. Under the advisement of Dr. Diego Fernandez, Thiros carried out research under his Undergraduate Research Opportunities Program grant, "Lead Isotope Analysis of Great Salt Lake, Utah, Microbialites in Response to Anthropogenic Lead Pollution."

Outstanding Teaching Assistant Award

Doctoral candidate David Wheatley received the 2017 CMES Outstanding Teaching Assistant Award. This award honors the teaching and educational service of one graduate student each year in the College of Mines and Earth Sciences and is considered one of the highest College honors. Wheatley has been the teaching assistant for three courses and their respective labs: Sedimentology and Stratigraphy, Field Methods, and Field Camp.

Photo by Cindy Greaves

Rocky Mountain Region Imperial Barrel Award

Team Kodachrome of the Department of Geology and Geophysics took second place in the annual Rocky Mountain Region Imperial Barrel Award contest, a petroleum exploration contest organized by the American Association of Petroleum Geologists.

East Asia and Pacific Summer Institutes Fellow

Geology and geophysics graduate student, Courtney Wagner, was named a 2017 East Asia and Pacific Summer Institutes fellow to China. Wagner's proposal, "Testing How Geomagnetic Field Strength Influences Magnetoreception and Biodiversity as Observed in Agnetotactic Bacteria," was funded by the National Science Foundation. Wagner spent the summer working with Dr. Yongxin Pan, one of the top researchers in the field of microbial magnetoreception and biomineralization. He is the director of the Biogeomagnetism and Biomineralization Laboratory at the Institute of Geology and Geophysics of the Chinese Academy of Sciences in Beijing.

NACE Book Award

Gaosong Yi received a 2017 National Association of Corrosion Engineers (NACE) Graduate Student Book Award at the NACE Annual Meeting in New Orleans. This award is to assist graduate students in the development of their corrosion libraries. Gaosong is a doctoral student advised by Dr. Michael Free in metallurgical engineering.

Richard Rubin Memorial Award

Behzad Vaziri Hassas, a metallurgical engineering MS student under the supervision of Distinguished Professor Jan D. Miller, was awarded the International Precious Metals Institute (IPMI) Richard Rubin Memorial Student Award (2017) sponsored by Republic Metals. Hassas was also recognized for his research on the fundamental aspects of auriferous pyrite flotation with nitrogen and carbon dioxide. The research project was supported by the Newmont Mining Corporation, the results of which provide a basis for new process design in the flotation of auriferous pyrite ores.

MEI Young Persons Award

Swadhin Saurabh, a graduate student in metallurgical engineering, received the 2016 Minerals Engineering International Young Persons Award in Falmouth, United Kingdom, for his outstanding contribution to minerals engineering. He is advised by Dr. Raj Rajamani.

Innovations in Nuclear Technology Innovation Award

Adam Burak, a doctoral candidate advised by Dr. Michael Simpson in metallurgical engineering, received an Innovations in Nuclear Technology R&D Award from the Department of Energy. These awards are given each year by the DOE Office of Nuclear Energy based on published research in the prior year.

Outstanding Faculty Teaching Award

Dr. Siva Guruswamy, professor of metallurgical engineering, received this past academic year's Outstanding Teaching Award. This student-driven award is considered the highest teaching honor in the College of Mines and Earth Sciences. The award was presented by Dean Butt at the spring convocation ceremony.

Carl-Gustaf Rossby Research Award

Dr. Edward J. Zipser, professor of atmospheric sciences, received the Carl-Gustaf Rossby Research Award, considered the highest honor bestowed by the American Meteorological Society.

Grover E. Murray Memorial Distinguished Educator Award

Dr. Cari Johnson, professor of geology and geophysics, received the 2017 Grover E. Murray Memorial Distinguished Educator Award from the American Association of Petroleum Geologists (AAPG). This award is given in recognition of distinguished and outstanding contributions to geological education.

American Geophysical Union Fellow

Dr. Thure Cerling, distinguished professor of geology and geophysics and distinguished professor of biology has been named a Fellow of the American Geophysical Union. AGU Fellows are AGU members who have made exceptional contributions to Earth and space sciences as valued by their peers and vetted by section and focus group committees. Cerling is also a Member of the National Academy of Science and is currently serving as Chair of a National Academy Committee on coal mining.

Penn State Charles Hosler Alumni Scholar Award

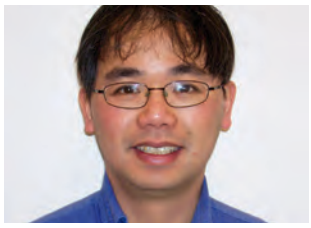
Dr. James Steenburgh, professor of atmospheric sciences, won the Charles Hosler Alumni Scholar Award from Penn State's College of Earth and Mineral Sciences for contributions to the development of science through teaching, research, and administrative leadership.

NSF CAREER Grant

Dr. Lowell Miyagi, assistant professor of geology and geophysics, received a

National Science Foundation CAREER Grant for his project entitled, "Deformation and Anisotropy Development in the Lower-Most Mantle."

Celebrate U Awards



Dr. Brenda Bowen, associate professor of geology and geophysics and director of the Global Change and Sustainability Center, and Dr. John Lin, associate professor in atmospheric sciences, both received this award from the University of Utah for their interdisciplinary research in earth sciences.

Francis W. Reichelderfer Award

Dr. John D. Horel, professor of atmospheric sciences, received the Francis W. Reichelderfer Award for development and leadership of the MesoWest observational network and for his support of operations, research and education to improve the understanding and forecasting of mountain meteorology.

Beacons of Excellence Award

The Frederick Albert Sutton Building is a 2017 Recipient of the U Beacons of Excellence Award. This is the first time the Award went to a building rather than a person. The Beacons of Excellence Award is a way for the university to recognize the people, programs and projects committed to fostering a transformational experience for all students. The Award was accepted by several of the faculty who were instrumental in its design including Dr. Marjorie Chan and geology and geophysics department chair, Dr. Thure Cerling (on behalf of the late Dr. Frank Brown).

Designing a Better Battery

U RESEARCHERS HAVE DEVELOPED A SAFER, MORE AFFORDABLE, MATERIAL FOR LITHIUM-ION BATTERIES

By Lisa Potter

First successfully marketed in 1991 by Sony Corporation, lithium-ion batteries are now common place, with widespread use in flexible and portable electronic devices, transportation systems such as hybrid and electric vehicles, and aircraft. They impact our lives in a multitude of ways and an enormous market of over $10 billion is expected by 2020. However, with increasing attempts to pack more energy and miniaturization, there is increasing potential for fire danger in the current Li-ion batteries, highlighted by recent battery fires in Boeing Dreamliner aircraft, the Samsung Galaxy Note 7, laptop computers, and other electronic devices. The lithium-ion (Li-ion) battery packs used in these devices are constructed with a highly flammable liquid electrolyte. If the battery short-circuits, the liquid electrolyte can quickly heat up and cause the battery to catch fire and explode. Samsung and others, including government agencies, are investigating the problem to determine why this is happening. Even before the difficulty with the Samsung Galaxy Note 7, researchers in professor Jan D. Miller's group in the Department of Metallurgical Engineering were engaged in the development of lithium batteries with high energy density and safety, including the lithium-sulfur battery and the lithium-air battery. Research is in progress to design electrodes and electrolytes for these advanced lithium batteries and Miller's group has developed Li-ion battery technology that can solve this problem while delivering high energy outputs. The group includes Dr. Xuming Wang and Qinyu Zhu and collaborates with researchers from Brigham Young University as well as from China's South Central University.

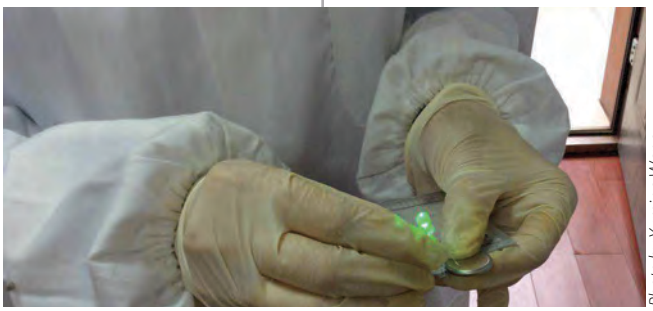


Photo by Xuming Wang

Demonstration of LED energized by one of the first solid polymer HNT lithium batteries being developed at the College of Mines and Earth Sciences at the University of Utah.

Battery design depends on the device needs. For example, hybrid vehicles need batteries that hold a higher total amount of energy. While the design needs may differ, both systems need batteries with improved ability to conduct electricity and to speed up transport of the lithium-ion from one electrode to another through the electrolyte. Conventional liquid or gel electrolytes can provide

satisfactory performance, but as the Samsung Galaxy Note 7 has demonstrated, solvent leakage and flammability is problematic.

The use of a solid polymer electrolyte instead of the conventional liquid or gel electrolyte can drastically improve the safety aspects of a Li-ion battery. A solid polymer electrolyte based lithium sulfur (Li-S) battery is the most promising system for next-generation batteries because of its high capacity for storing energy. In addition, sulfur is an abundant and relatively inexpensive material. However, existing polyethylene oxide-based (PEO)-based solid electrolytes do not meet the functional performance requirements. At low temperatures, their conductivity is poor due to the presence of crystalline PEO segments, which restrict the lithium ion mobility. This limits the useful operating temperature of Li-ion polymer batteries to between 70°C and 100°C, which excludes the use of solid polymer based batteries in room temperature commercial applications.

Miller's research group has developed a new nano-composite material as a potential solid polymer electrolyte that exhibits high Li-ion conductivity at room temperature and below, along with good mechanical properties. A key component of the new electrolyte is halloysite, a natural nanotube material and unique Utah resource, which significantly improves the PEO-based solid electrolyte performance, especially at room temperature. The halloysite nanotube (HNT) is a super-fine aluminosilicate with a naturally occurring tubular structure at the nanoscale. It has gained wide interest in the preparation of complex structures as an economically available nanotubular raw material.

The use of halloysite is expected to provide many technical and economic advantages for lithium battery technology. The new halloysite nanocomposite solid-state electrolyte is a thin, almost transparent, membrane and will make possible the use of high energy all solid-state lithium batteries over a wide range of temperatures. In addition, the use of this membrane electrolyte will make simplified, lower weight, all solid-state cells that are safer for use in vehicles and in a myriad of other applications. Not only does this technology improve battery performance, but it also creates a new market for production of halloysite from Utah's mineral resources. The Tintic mining district of Juab County in central Utah is one of the major resources for high quality halloysite nanotubes. Miller's research group has filed the first provisional patent for the new battery technology. The research program is supported by a USTAR/UTAG grant from the State of Utah to develop solid polymer electrolytes for lithium batteries.

Photo by Applied Minerals

Halloysite is a natural nanoparticle that is found in abundance in Juab County, Utah.

Improving Hurricane Forecasting

The 2017 Atlantic hurricane season officially began June 1. As each hurricane barreled through the Atlantic, potentially threatening the U.S. East Coast, forecasters worked to determine a storm's probable path and intensity in order to make appropriate recommendations to the regions in the storm's path. Zhaoxia Pu, a professor of University of Utah's Department of Atmospheric Sciences, is one of the scientists using computer models and algorithms to improve hurricane forecasting. Pu and her graduate students are currently involved in the National Oceanic and Atmospheric Administration's "Hurricane Forecast Improvement Project (HFIP)," aimed at improving the nation's capability in predicting hurricanes. In particular, her research uses radar and satellite observations to improve the data inputs that are essential for these computer models to produce more accurate hurricane forecasts.

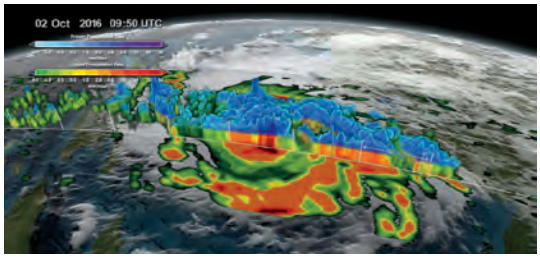


Photo by NASA

NASA Global Precipitation Measurement (GPM) satellite captured the precipitation data from Hurricane Matthew on the morning of October 2, 2016, when it was a Category 4 Hurricane immediately south of Haiti and the Dominican Republic.

UNRAVELING A MYSTERY
BELOW THE SURFACE OF GREENLAND

By Paul Gabrielsen with Mahala Kephart

The Greenland ice sheet is 1,500 miles long and nearly 700 miles wide, covering about eighty percent of the island; the ice is up to two miles thick. In eastern Greenland, where University of Utah scientists are still studying this vast ice sheet, the mean temperature is about -25 degrees F.

This remote and very cold place is home to a baffling puzzle. In 2011, a team of researchers led by Dr. Richard Forster of the University of Utah's Department of Geography were conducting studies that involved drilling ice cores and measuring their volume and mass. "We were shocked," says Forster, "when we pulled up an ice core and there was liquid water just gushing out of it."

Why would water exist – unfrozen, trapped underneath a thick ice sheet – in one of the coldest places on the planet? Trying to answer that question is how a collaboration with researchers from the Department of Geology & Geophysics, including Professor Kip Solomon and graduate student Olivia Miller, and funded by the National Science Foundation, was formed.

To say their field area, which is more than an hour's helicopter flight from the village of Kulusuk, on the eastern coast of Greenland, is rugged is a gross understatement. While in the field, scientists like Forster, Miller, and Solomon live in tents on the ice, sleeping at night with their satellite phone batteries, equipment, and samples that cannot freeze tucked deep into their parkas and sleeping bags.

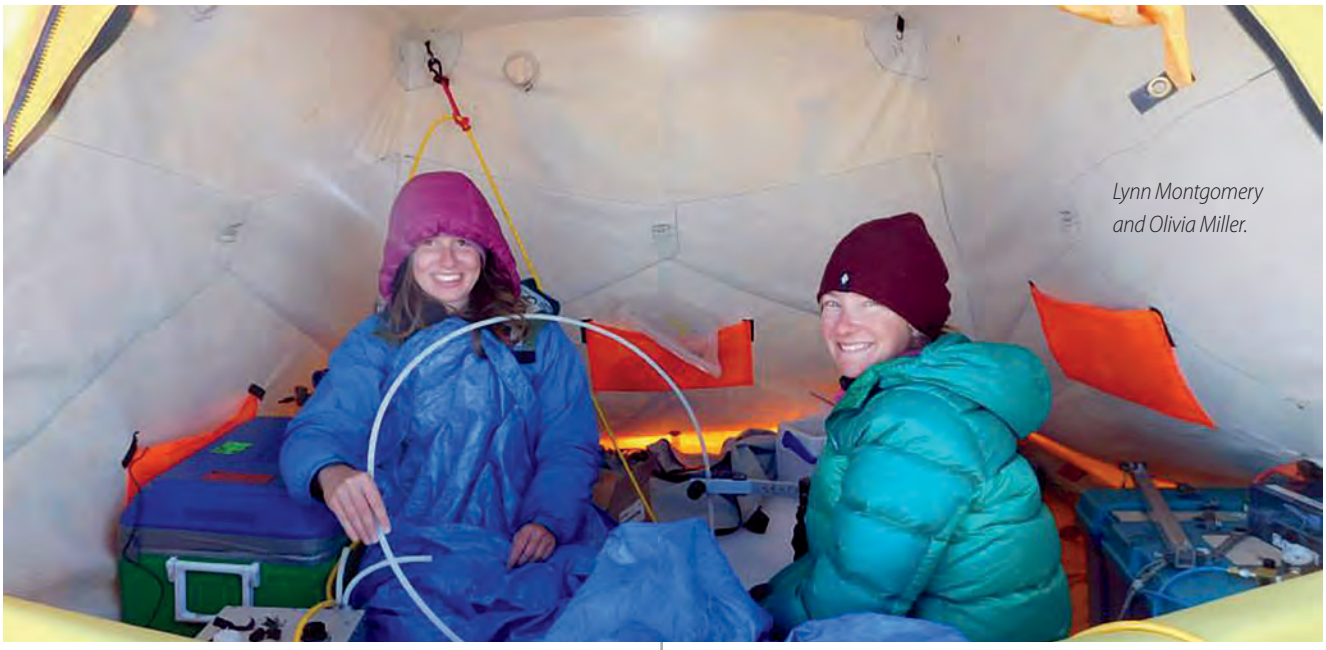
But during their active research time in the daylight hours, these scientists patiently drill boreholes into the ice and send probes deep into the snow. They've poured special fluorescent dyes onto the surface of the snow to see how long it takes to percolate to the aquifer below (about two days) and they've poured dyes into the aquifer to try to measure other aspects of how it behaves.

They have, in essence, completed a map of this huge aquifer of unfrozen fresh water that is between 60 and 70 feet thick. That aquifer is below the fir (the snow – ice porous mixture that is 60 to 120 feet thick) and above the solid ice that extends to the bedrock, some 1000s of feet below the surface. "This aquifer," notes Miller, "stays liquid year-round, even through the winters."

Solomon's team suspects the snow on top of the ice sheet acts like a heavy, warm blanket (warm for Greenland!). "What seems

Kulusuk, Greenland

Photo by Clement Miege



Lynn Montgomery and Olivia Miller.

Photo by Nicholas Schmerr

to be happening," Solomon notes, "is that this warming in the summer melts the snow, and that water percolates down to the aquifer, which is deep enough to be insulated from the winter cold."

Even if that turns out to be the explanation, some big questions are still on the table.

"The big question," Miller said, "is how much of this water is going into the ocean, and how fast is that happening." Is the aquifer inside the ice a symptom of climate change? Or did it develop even before modern-day warming began? Could the fresh water found in the ice play a role in speeding up the meltdown and the rising of sea-levels?

"If this water gets to the base of the ice sheet, it could speed up the glaciers and then they would deliver more ice to the oceans – and that would increase the rate of sea-level rise," Solomon said. "There's lots of evidence that this part of the world is warming quite dramatically. I don't believe the sky is falling, but we need to understand the role that this mechanism has in the melting of the Greenland ice sheet. We previously just didn't know that this reservoir of fresh, unfrozen water even existed."

Photo by Clement Miege

Dr. Nicholas Schmerr observes flourescent dye flowing through a firn core.

Photo by Clement Miege

Professor Kip Solomon and Olivia Miller testing field equipment to drill a well in the ice sheet.

SEISMIC SLEUTHS

MICHAEL McCARTER SEARCHES EARTHQUAKE SIGNALS TO IMPROVE MINING SAFETY

By Lisa Potter

For most of his career, Michael "Kim" McCarter, McKinnon Endowed Chair and professor in the Department of Mining Engineering, has explored ways to limit damage to mine openings resulting from the mini-quakes caused by routine blasting. In the twilight of his 50-plus years as a mining engineer, McCarter now studies these mini-quakes that can risk the lives of miners.

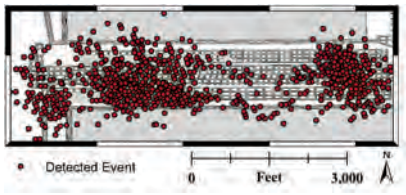
Micheal "Kim" McCarter

McCarter leads collaborative research that studies mining-induced seismic events. Using the University of Utah's vast network of seismographs, his team mines seismic recordings, searching for patterns that distinguish between a natural tremor and a mining-induced quake. McCarter and collaborators analyze seismic signals to improve mine safety and create safer working conditions.

Along the way, McCarter has mentored a new generation of graduate students and tenure-track faculty who specialize in critical mining-safety issues.

"Most of these mining events aren't noticed by people because they're very small," says McCarter. "But if we knew how to analyze these small events, then we could tell whether the mine is progressing as planned, or if things start happening differently than what we expect."

Photo by Pratt Rogers



MINING-INDUCED EARTHQUAKES

In 2011, McCarter won a five-year grant from the Centers for Disease Control's National Institute for Occupational Safety and Health aimed at training graduate students to become experts in mining safety. McCarter and his students teamed up with the University of Utah Seismograph Station to sift through seismic data to identify the signatures of earthquakes caused by natural mechanisms, and those caused by mining.

When miners remove dirt and ore, they change the stress fields surrounding the surface of a mine. If poorly managed, this could lead to potentially dangerous structural failures. The seismographs record these tremblers along with the natural quakes, but because Utah's coal mines sit in the middle of the earthquake-prone Intermountain Seismic Belt, the two are not easily distinguished.

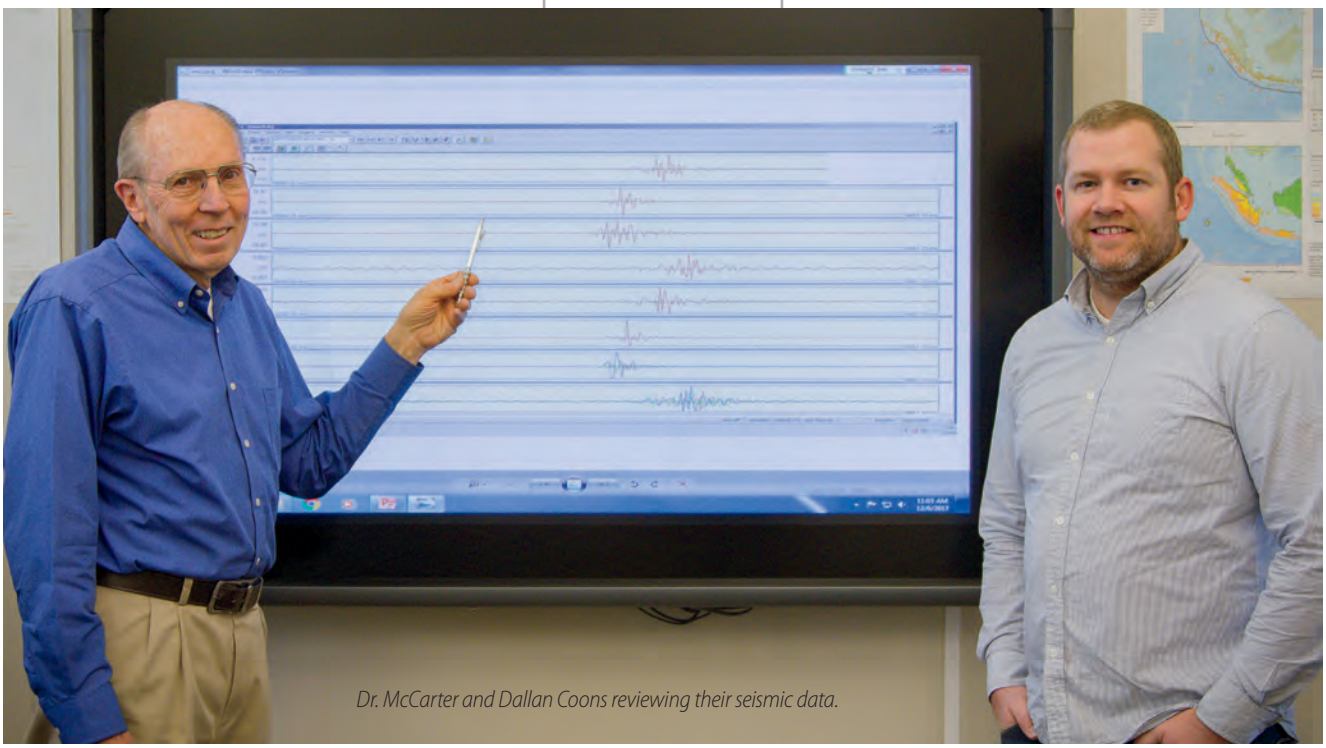
> *"There's a lot of information coded in those events that would help us understand a mine's stability, and help improve safety."*

"Over the last five years, we've been able to increase our ability to detect very small events," says McCarter. "There's a lot of information coded in those events that would help us understand a mine's stability, and help improve safety."

In a pioneering study, Tex Kubacki a former graduate student of McCarter's and now at Malin Space Science Systems Inc, analyzed the 2007 Crandall Canyon disaster in which nine people died when the coal mine collapsed. The researchers analyzed seismic data before, during, and after the failure, and discovered nearly 1,500 tiny earthquakes that were previously unrecognized. These tremors helped map the dynamics of the collapse.

The research group has also developed software that compares seismic events to look for similarities. "If the tremors come from the same place, and were triggered by the same mechanism, that can tell you a lot about what's going on in the mine," says McCarter.

"A lot of information can be determined by just looking at the seismic response. There are mathematical ways of determining the source mechanism, and being able to locate where they're occurring," says McCarter. "If we can just interpret them correctly, I believe that seismic events would provide information on the condition of the mining environment."



Dr. McCarter and Dallan Coons reviewing their seismic data.

Photo by Cynthia Meier

HEALTH AND SAFETY IN MINING

Dr. Pratt Rogers is a new assistant professor in the Department of Mining Engineering at the University of Utah. His research and professional experience focus on the role of digital innovation and data management in mining companies. The future of sustainable mining will depend on smarter sociotechnical systems that consider the human, natural, and financial sources of capital. Although digital technologies enable this complex integration of management, implementing these technologies will require a big shift in the culture and approach to mining management. Pratt hopes to use his deep industry connections to create research partnerships with a variety of mining companies as a development and testing ground in a variety of research areas, including health and safety.

Here at the U, Pratt is collaborating on a project with Mining Engineering Department Chair Mike Nelson that assesses the effectiveness of health and safety management systems in the mining industry. This complex project requires him and his team to visit many mine sites to survey the workforce and characterize the safety management systems of each mine. They will compare these surveys against safety outcomes, such as incident rates and regulatory violations, to provide valuable insight into what works to improve mine safety.

The increased demand for water as a result of urban growth affects the carbon storage ability of the mountains.

CO_2 AT THE INTERSECTION OF URBAN AREAS AND MOUNTAIN RANGES

Dr. John Lin is interested in how CO_2 is emitted and removed from the atmosphere in cities, as well as in mountainous regions. He and his colleagues published a study this past May in Atmospheric Chemistry and Physics that discusses carbon emissions and cycling at the intersection of mountains and urban areas. The study is titled, "How can mountaintop CO_2 observations be used to constrain regional carbon fluxes?" It focuses on three mountainous sites in the American Rockies, where large urban areas — Salt Lake City and Denver — are located nearby at lower elevations. Lin and his colleagues found that because of the complex terrain of mountains, atmospheric models can sometimes misinterpret CO_2 data.

The trending growth at the intersections of urban areas and mountains leaves no doubt that it is critical that data on carbon fluxes is properly understood everywhere. And this issue, while more complex in mountainous regions, is globally significant. As the study notes, more than half of the world's population lives in urban areas, where most CO_2 is found, and as of 2000, over 10% of the world's population lived in mountainous areas. Lin points out that as cities engage in land use system planning to attempt to reduce greenhouse gas emissions, it is critical that scientists as well as city planners and ecologists have the tools to accurately understand how much, where, and why a city emits a certain amount of carbon in order to track emissions and assess the effectiveness of mitigation strategies.

Photo by Luke Leclair-Marzolf

University of Utah researchers Logan Mitchell (left) and Ben Fasoli (right) maintaining air quality and greenhouse gas instruments on top of a TRAX train in support of a project that is seeking to better understand the spatial patterns of air pollutants and greenhouse gases across the Salt Lake Valley.

Photo by Dave Titensor

Breathing Easy

SENSOR SCREENS FOR TUBERCULOSIS USING ONLY A BREATH

Patients breathe easier with a portable sensor that detects the early stages of TB.

According to the World Health Organization, 9.6 million people suffered from TB and over 1.5 million died from it. Poverty, socio-economic factors, and access to clinics are factors affecting the spread of this highly contagious disease, with these factors further complicated by the current waiting time required for screening results and diagnosis.

Early stage screening is very critical for preventing the spread of the disease. Dr. Manoranjan Misra, USTAR professor of metallurgical engineering and chemical engineering along with Dr. Swomitra Mohanty, assistant professor of metallurgical engineering and chemical engineering have developed a technology for rapid, non-invasive and inexpensive early stage detection of the disease. The technology is based on the use of functionalized titanium dioxide nanotubes to detect TB using the biomarker in the breath. It is known that active TB infection in the lungs gives off four biomarkers that are byproducts of the bacterial metabolism. As the breath of an infected individual is passed over the arrays of nanotubes, the biomarkers bind to the nanotubes and give a detectable current that can be measured by a handheld device. The detection of the biomarkers takes only a couple of minutes. The device is noninvasive as it uses the human breath. It is inexpensive as the sensor costs are extremely low and the detection system is portable. This allows large scale screening and global tracking and prevention of the spread of the disease.

Nanomaterials Based Sensor Technology for Rapid, Non-invasive and Inexpensive Tuberculosis (TB) Screening

The investigators have been working on this technology since 2011. The project has attracted the attention of government agencies and private foundations such as NIH, NSF USTAR, and the TB Grand Challenge in India (Gates-USAID). Currently active field trials are in progress in India and Uganda. This technology will help healthcare professionals worldwide to increase the number of individuals who receive screening for TB, resulting in earlier treatment which can prevent human suffering and reduce the spread of this highly contagious disease.

Left to right: Jory Lerback, Pam Hofmann, Gabriela St. Pierre, Seanna Hood, and Samantha Davis

INCLUSIVE EARTH

Inclusive Earth is a student group organized in the fall 2016 by graduate students of the College of Mines and Earth Sciences (CMES) with the ultimate goal of building a platform to unify members of the college and encourage diversity, collaboration, and inclusivity in CMES and across campus. They aim to facilitate the growth of academic and social relationships between faculty, staff, graduate students, and undergraduate students in all CMES departments (Atmospheric Sciences, Geology and Geophysics, Metallurgical Engineering, and Mining Engineering) in order to promote a strong and supportive network of people and a greater sense of community. Part of that mission is to provide a space that encourages the support and success of all members of our college through networking and social functions, interactive discussions, and professional development workshops. They believe that Inclusive Earth has the potential to play a valuable role in unifying CMES by promoting new communication pathways, strengthening relationships, and encouraging academic diversity.

MOVE MINING COMPETITION

Move Mining is a competition that encourages new ideas, collaboration and technology to work together to change the world's perception of the mining industry. The inaugural competition occurred in February 2017 at the annual Society of Mining, Metallurgy, & Exploration (SME) Conference.

A team made up of CMES students - Leigh Seeley, Kylie Boyce and Gaby Seeley (a graphic design major from Utah Valley University) and CMES staff members - Samantha Davis and Pam Hofmann submitted a concept paper that was selected for the final competition last February. Their concept was to promote mining awareness through social media and annually at the SME conference by offering access and workshops to area high school students. Although their concept was not chosen as the winner, the experience was an excellent opportunity to represent the college and university.

Left to Right: Gabi Seeley, Leigh Seeley, Samantha Davis, Pam Hofmann, Kylie Boyce

WELCOME NEW FACULTY

Gannett Hallar

Dr. Gannet Hallar joined the Department of Atmospheric Sciences as an Associate Professor. She was hired under the auspices of the Transformative Excellence Program to collaborate with faculty members across campus on interdisciplinary research topics related to Society, Water, and Climate (SWC).

The overarching theme of Hallar's research is using high quality measurement of trace gases, aerosol physical and chemical properties, and cloud microphysics to understand connections between the biosphere, atmosphere, and climate. She holds a Bachelor of Arts in Physics from Truman State University and a master's and doctorate in atmospheric and oceanic sciences from the University of Colorado at Boulder. Prior to joining the U she was at Desert Research Institute (DRI) where she held positions as a Full Research Professor and Director of Storm Peak Laboratory (SPL) in Steamboat Springs, Colorado. Hallar has more than 50 peer-reviewed publications. She received

WELCOME NEW FACULTY

the Peter B. Wagner Medal of Excellence for early career DRI scholars in 2011 and the Regents' Rising Research Award from the Nevada System of Higher Education Board of Regents in 2012.

Krista Carlson

Dr. Krista Carlson joined the Department of Metallurgical Engineering as an Assistant Professor. Carlson's research is focused on the development of innovative materials-based solutions to anthropogenic-influenced environmental issues. Within this environmental theme, her research platform focuses on the development of materials and applications that include customized aerogel composites, integrated waste containment and glass recycling technologies, and advanced materials for decentralized drinking water purification technologies.

Carlson and her colleague, Dr. Swomitra Mohanty, Assistant Professor in both Chemical Engineering and Metallurgical Engineering, recently developed a new solar powered water purification device that will make iodine-treated drinking water unnecessary. The device, now developed and marketed by SolaPur, uses sunlight to kill disease-causing viruses, bacteria, and protozoa. The technology can be easily adapted for use in outdoor recreation, emergency preparedness, or in developing regions of the world that currently lack access to clean drinking water.

York Smith

York Smith joined the Metallurgical Engineering faculty in July 2016. His love for snow covered peaks and open spaces had led him to the University of Nevada, Reno where he obtained his bachelor's and master's in chemical engineering. Given his only criterion was decent skiing, he then moved to the University of Utah where he obtained his Ph.D. in Metallurgical Engineering. After a postdoctoral research award from the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Smith joined the CMES faculty as an assistant professor. He specializes in chemical metallurgy with current research interests in nonferrous metal recycling, electrochemistry, interfacial phenomena, and sustainable/green metallurgical engineering.

Pratt Rogers

Dr. Pratt Rogers, a new assistant professor in Mining Engineering, received his bachelor's degree and Ph.D. in Mining Engineering at the University of Arizona. Rogers has extensive business and research experience in socio-technical systems, big data analysis, mining technology, safety and health management systems. The future of sustainable mining will depend on smarter sociotechnical systems that consider the human, natural, and financial sources of capital.

He is a Co-PI on an Alpha Foundation sponsored project assessing the effectiveness of Safety and Health Management Systems at U.S. mines. Rogers hopes to use his deep industry connections to create research partnerships with a variety of mining companies as a development and testing ground in a variety of research areas.

Jeff Johnson

Dr. Jeffrey Johnson received his bachelor's, master's, and doctorate in mining engineering in Mining Engineering at the University of Utah. He is nationally recognized for his work in instrumented rock bolts and methods to install them without compromising mine operations.

Johnson has authored over 30 publications and holds a U.S. Patent. As a new faculty member, Johnson provides expertise in teaching rock mechanics and engineering design courses in the undergraduate and graduate programs.

Jessica Wempen

Dr. Jessica Wempen received her bachelor's, master's, and doctorate in mining engineering in Mining Engineering at the University of Utah. She is a licensed professional engineer in the State of Utah and has expertise in mine planning and design. She has participated in research in two arenas critical to mine safety: mine ventilation and ground control. Currently, she is a Co-PI on a research project funded by the National Institute of Occupational Safety and Health focused on measuring surface displacements using satellite-based remote sensing and analyzing mining-induced seismicity to improve mine ground control safety. The application of new technologies in the mining industry is an important component of current mining research, and there is significant potential to use remote sensing, including satellite-based radar, to help address important environmental and ground control questions.

A Conversation with Alumnus, Rex Plaizier

Rex Plaizier is President and CEO of WesTech Engineering, Inc., an internationally recognized company that is headquartered in Salt Lake City and has operations around the globe. WesTech Engineering designs and manufactures process equipment for industrial, mineral, municipal water and municipal wastewater industries. In 2014, WesTech received the Bill Daniels Ethical Leadership Award for Business in recognition of the company's demonstrated "integrity, trust, accountability, transparency, fairness, respect, rule of law, and viability."

Plaizier earned bachelor's (B.S. '93) and master's (M.S. '91) degrees in mining engineering and an MBA ('91) from the University of Utah. While a graduate student, he was selected as a Fulbright Scholar and studied mining engineering at the University of Aachen in Germany for 13 months. He is fluent in English, Portuguese, and German. He strives to learn something new each day.

Recently, Kylie Boyce, a mining engineering undergraduate at the U sat down with Plaizier to talk about, among other things, his faculty mentors at the University of Utah.

Kylie: Something I would really like to ask you about are the "Three B's" that you discussed at the mining engineering award banquet last spring?

Rex: You mean do your best work, think outside the textbook, and that there are no boundaries to learning? Sure!
The "do your best work" lesson came from Dr. Hucka. He was my advisor and he was from Czechoslovakia. He expected his students to really perform and had a great impact on my life, I was complaining about a grade and he asked me if it was the best I could do. I told him it wasn't. In response, he said," Why would you ever do anything less than the best you can do?" Great question.


Rex Plaizier

The "thinking outside the textbook" lesson is what I learned from Dr. Wells. We were taking a class on mine economics and he gave us a problem about an existing ore body with the grade and cost to mine it. As we went through the standard book calculations and methods of doing it, the whole class concluded it could not be profitable and was not economically viable. Dr. Wells disagreed. So we ran back and read the book again and just couldn't see what he was talking about. So that's when I went to his office and said, "Ok, Dr. Wells, what are we not getting?" That's when he taught me a great life lesson. He said you need to think outside of the book and not restrict your thinking to just what is in the book. About the problem the class was working on, he asked, "What if you did it in phases?" That little encounter planted a seed that started the thought process in my head. I went back to my group and I said, "What, if we do just this section first and then that section, then kind of blend it in, then it is profitable. And not only is it profitable but it is a really good project." Thinking outside of the box (or textbook, in this case) is an exhilarating thing!

It was through Dr. McCarter's influence that I learned the "there are no boundaries" lesson. I remember going up and talking to him while he was in the explosives shop, which was brand new and exciting. He was actually soldering this very elaborate semiconductor electronic circuit board. I was like, "Whoa, I never learned that in mining engineering!" I was very impressed and asked if someone else had designed the equipment he was working on and he said, "No, I designed this and now I'm assembling it." I asked if he had some sort of electronics class and he said, "No, I just learned it." I then asked if these were skills you need to have as a mining engineer and he said something like, "I don't put any boundaries on my learning. I learn whatever I can and as much as I can." Today, young engineers now ask me, "How do you know that?" I call it a yearning for learning — if you look for opportunities to learn, you will find them.

The "Three B's" I learned from these University of Utah faculty mentors were great life lessons and have helped me much in my career.

Kylie: Thank you!

NUCLEAR NON-PROLIFERATION EXPERT VISITS

Metallurgist and nuclear weapons expert, Dr. Siegfried S. Hecker, visited the College to deliver a Frontiers of Science Lecture on North Korea and its nuclear weapons program. Hecker is a research professor in the Department of Management Science and Engineering and a senior fellow at the Freeman Spogli Institute for International Studies (FSI) at Stanford University. He was co-director of the Center for International Security and Cooperation at Stanford from 2007-2012. From 1986 to 1997, Hecker served as the fifth Director of the Los Alamos National Laboratory.

Hecker is one of the few U.S. citizens to have spent time in North Korean nuclear facilities. He delivered a photo-rich lecture that described the growth of the North Korean program over the past sixty years, how they obtained the technology and why. He also expounded prophetically on the challenges of what might be faced by the current administration.

FRANCIS H. BROWN PASSES AWAY

By Thure E. Cerling, Chair, Department of Geology and Geophysics

It is with great sadness we share the loss of our dear friend and colleague Francis H. Brown. Frank passed away suddenly and unexpectedly the afternoon of Saturday, September 30, 2017.

In his 46 years at the University of Utah, Frank served multiple roles: professor, chair of the Department of Geology and Geophysics, and dean of the College of Mines and Earth Sciences, stepping down from the deanship in 2016 after a tenure that spanned more than a quarter of a century. He was awarded the University of Utah's highest honor, the Rosenblatt Prize, in 2001 in recognition of his accomplishments in research, teaching and administration. His colleagues and students will remember him best in his roles as teacher, mentor and friend.

Frank's life work was the geology of the Turkana Basin in East Africa. His first field season was in 1966, and in the ensuing fifty years of work there, he provided the chronologic framework that allows understanding of human evolution in East Africa. He mapped volcanic ash layers across the landscape, correlated them using micro-chemistry, and dated them with the K-Ar method. He was always willing to take others to the field, to work on knotty problems, and to question his own earlier conclusions when new evidence presents itself. As one colleague noted in learning of Frank's passing, "Frank always made us think harder and walk farther."

Over the years, his loans of financial support made it possible for University of Utah students to continue their studies and for friends in Kenya to launch new endeavors. His quiet generosity was legendary. Frank supported the educational and research expenses of many African secondary schools, undergraduate, and graduate students and established the Francis H. Brown African Scholarship Fund under the auspices of the Leakey Foundation to continue providing educational support to African students. To learn more about the fund, or to make a gift in Frank's memory, please visit: *www.leakeyfoundation.org/frankbrown.* To read Frank's full obituary, please visit: *www.legacy.com/obituaries/saltlaketribune/obituary.aspx?n=francis-brown&pid=186851473&fhid=23304*

Words simply cannot express the magnitude of our loss.

BOOKS BY UNIVERSITY OF UTAH AUTHORS

SECRETS OF THE GREATEST SNOW ON EARTH

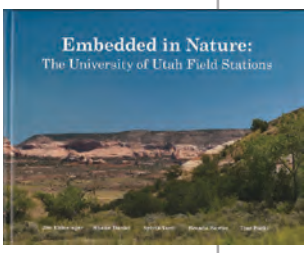
by Jim Steenburgh

Utah has long claimed to have the greatest snow on Earth—the state itself has even trademarked the phrase. In *Secrets of the Greatest Snow on Earth*, Jim Steenburgh investigates Wasatch weather, exposing the myths, explaining the reality, and revealing how and why Utah's powder lives up to its reputation. Steenburgh also examines ski and snowboard regions beyond Utah, making this book a meteorological guide to mountain weather and snow climates around the world. Steenburgh is a professor in the Department of Atmospheric Sciences at the University of Utah.

WINDOWS INTO THE EARTH: THE GEOLOGIC STORY OF YELLOWSTONE AND GRAND TETON

by Robert B. Smith (Author), Lee J. Siegel (Author)

Millions of years ago, the North American continent was dragged over the world's largest continental hotspot, a huge column of hot and molten rock rising from the Earth's interior that traced a 50-mile wide, 500-mile-long path northeastward across Idaho. Generating cataclysmic volcanic eruptions and large earthquakes, the hotspot helped lift the Yellowstone Plateau to more than 7,000 feet and pushed the northern Rockies to new heights, forming unusually large glaciers to carve the landscape. It also created the jewel of the U.S. national park system: Yellowstone. Meanwhile, forces stretching apart the western U.S. created the mountainous glory of Grand Teton National Park. These two parks, with their majestic mountains, dazzling geysers, and picturesque hot springs, are windows into the Earth's interior, revealing the violent power of the dynamic processes within. Smith and Siegel offer expert guidance through this awe-inspiring terrain, bringing to life the grandeur of these geologic phenomena while revealing the forces that have shaped--and continue to shape--the greater Yellowstone-Teton region. Over seventy illustrations--including fifty-two in full color--illuminate the breathtaking beauty of the landscape, while two final chapters provide driving tours of the parks to help visitors enjoy and understand the regions wonders. Fascinating and informative, this book affords us a striking new on the Earth's creative forces.



These two parks, with their majestic mountains, dazzling geysers, and picturesque hot springs, are windows into the Earth's interior.

EMBEDDED IN NATURE: THE UNIVERSITY OF UTAH FIELD STATIONS

The University of Utah Global Change and Sustainability Center recently released *Embedded in Nature: The University of Utah Field Stations,* a coffee table history of the university's six field stations. The book explores the history and use of each station through stories, photos and maps. It is available for $29.95 at the University Campus Store.

Embedded in Nature: The University of Utah Field Stations explores six field stations, including Bonderman Field Station at Rio Mesa, Range Creek, Red Butte Canyon Research Natural Area, Taft-Nicholson Center for Environmental Humanities, Telescope Array and the university campus as a living laboratory. The book was written by the University of Utah's Jim Ehleringer, distinguished professor of biology, with co-authors Shaun Daniel, research associate in environmental and sustainability studies; Sylvia Torti, dean of the Honors College and professor of biology; Brenda Bowen, director of the Global Change and Sustainability Center and associate professor in the Department of Geology and Geophysics; and Tom Parks, former vice president for research. Ehleringer initiated the project as an invitation for more students to undertake field learning.

"Ask alumni what they remember of their undergraduate experiences, and many will quickly recall the excitement of their field station experiences, even decades after they have graduated from the university," Ehleringer said. "It is important to have information available in a coffee table book format that quickly shows students what rich and diverse outdoor training opportunities are available here at the University of Utah."

From the sagebrush steppe landscapes in the north to the sandstone landscape and a wild river in the south, the stations encompass a wide range of ecosystems in the Intermountain West. Scholarly activities at the stations facilitate rich intellectual exchange among artists, scientists and writers about these dynamic environments. Courses held in the stations enrich faculty teaching with place-based experiences for students.

For Bowen, the field stations encourage members of the university learning community to explore the interface of natural and human habitats.

"Our job as educators is to develop citizens

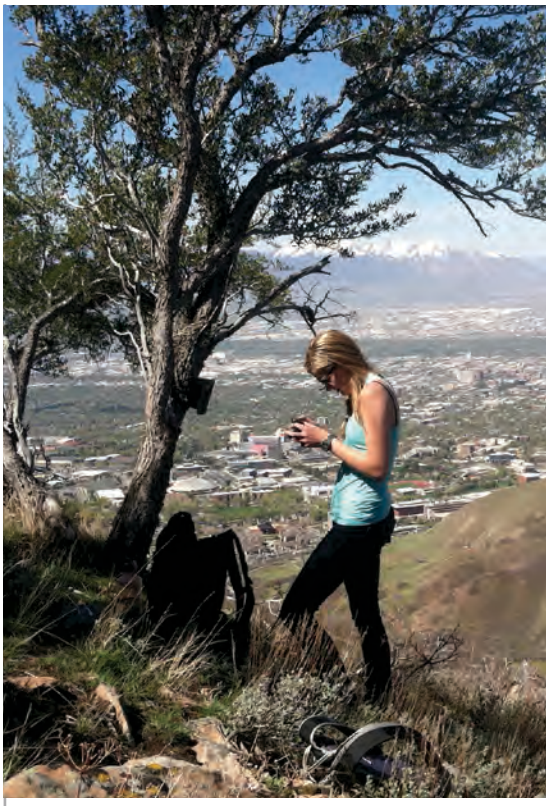
who are versed in a scientific understanding of the world who can also speak in terms of the economic, cultural, ethical and personal parameters of complex social issues," Bowen said. "These living laboratories help us take our students beyond their comfortable urban lives, instill a sense of wonder and infuse the quest for discovery and invention."

The book received generous financial support from the Office of the Vice President for Research, Ehleringer, the Global Change and Sustainability Center and the Honors College. The field stations described in the book are thoughtfully managed by colleges and units from across campus.

"The natural systems at the field stations are like libraries where the species might be thought of as books, their interactions like complicated plots of love — life and death — all unfolding before us in real time," Torti said. "These are places where we can peer into the past and envision new futures. The university's investment in field stations is exciting for us now but will become even more valuable to students and faculty of the future."

Embedded in Nature: The University of Utah Field Stations is available for purchase at the University Campus Store. All proceeds will support further research at the field stations.

Scholarly activities at the stations facilitate rich intellectual exchange among artists, scientists, and writers.



A student sets a camera trap to observe wildlife adjacent to Red Butte Creek (University of Utah campus in the background).

Genevieve Atwood teaches students about surface processes at the Bonderman Field Station at Rio Mesa.

COLLEGE OF MINES
AND EARTH SCIENCES
THE UNIVERSITY OF UTAH
115 S. 1460 East, Room 205
Salt Lake City, UT 84112-0102

UTAH SKI WEATHER FORECASTS THE GREATEST SNOW ON EARTH

By Peter Veals, doctoral candidate and Utah Ski Weather President

Many an atmospheric sciences grad student in Utah has had to answer the question from our friends and family, "How much is it going to snow in the mountains this weekend?" A few of us who have spent time playing in the mountains have given some good informal forecasts like this, but for the most part we all realize one thing: It's really hard to forecast mountain weather on the spot.

Two of the keys to the success and skill of operational meteorologists, at organizations like the National Weather Service, are the continuity of the job and the ability to learn from senior forecasters. In other words, taking a look at the models once a month with little experience in the intricacies of the local climate, it is difficult to make good forecasts for family, friends, or the public. Utah Ski Weather started sometime around 2005 as a way to both formalize the forecasting we already did as grad students and to provide practice and experience for those with an interest in operational meteorology. For those not interested in operations, it also provides a fun outlet for doing what we would already be doing in the office in January — talking about weather and skiing. Our website has gone through many changes and updates in the years since, including a move to a blog-style written forecast, but we have largely maintained the same mission and procedures.

We begin operations in late October or early November, and provide a forecast each evening throughout the ski season, usually shutting down in late April. The USW crew generally includes six to eight forecasters, each bringing their own unique perspective and style to the daily forecast.

Depending on the skill of the forecaster, this can be a good or bad thing, but it provides for a lot of fun around the office when one of us nails the forecast (or busts terribly). To see Utah Ski Weather's forecasts, visit *utahskiweather.com*

Peter Veals

Ute Weather Center New Space and Changing of the Guard

The Department of Atmospheric Sciences hosted an Open House for the newly remodeled Ute Weather Center, located on the 8th floor of the William B. Browning Building.