UNIVERSITY OF MARYLAND / **FEARLESS IDEAS**

Photo credit: Ernie Bell

INSIDE THIS ISSUE

LETTER FROM THE CHAIR

Dear Alumni and Friends,

As you might have guessed, 2020 has been a challenging year for the Department of Geology, due to the global pandemic. As with many universities, we saw the pandemic slowly coming our way last winter. We were sent home one day early before the official beginning of spring break in March. Following spring break we were given a two week period to convert all of our teaching (lectures and, gulp, labs!) to online presentations. Through the heroic efforts of everyone involved, especially the TA's for the lab courses, we somehow managed to do what I believe was a great job of continuing to educate our students at the highest level. Even our 393/394 senior thesis capstone final course presentations were conducted online (and will be presented online for fall 2020), and by all accounts were of highest quality. There were numerous other issues related to the pandemic. As most of you will recall, successful completion of field camp is a requirement for graduating with a degree in our geology program. Alas, all field camps everywhere shut down for the summer of 2020, so our students had to pivot to online field courses that were offered by a number of universities. Nearly all staff activities, such as scheduling and purchasing, as well as graduate and undergraduate advising, had to move online. And oh yes, 5% of our state budget was also taken back by the University…

For fall 2020 we were allowed to teach a few majors classes in person (students not wishing to attend had the option to attend remotely), but all university courses with greater than 50 students were held online because of the lack of lecture facilities of sufficient size to allow social distancing. Most of our course offerings will continue online in the spring of 2021. The laboratory portions of our majors classes are probably the most problematic to move online. This fall, we managed to provide in person teaching for a few labs by socially distancing attending students among our three teaching labs, connected by video to the instructor.

As I write this in late November, buildings on campus remain eerily empty, with only a fraction of our students continuing to live in the area and populate the campus. We've had mandatory Covid testing several times this fall, with students, faculty and staff who come to campus passing through a mass testing gauntlet set up in the football stadium or the Stamp Student Union. Most of our faculty, postdocs, students and staff have conducted their work from home, although some of us have been fortunate to continue laboratory work by scheduling our work to maintain necessary social distancing. I am grateful to everyone in the department who has worked so hard to allow teaching and research to continue in a safe manner throughout the pandemic. As with everyone on Earth, we hope that some level of normalcy can return for fall 2021.

Despite the fact that much of 2020 was a downer, some good things actually did

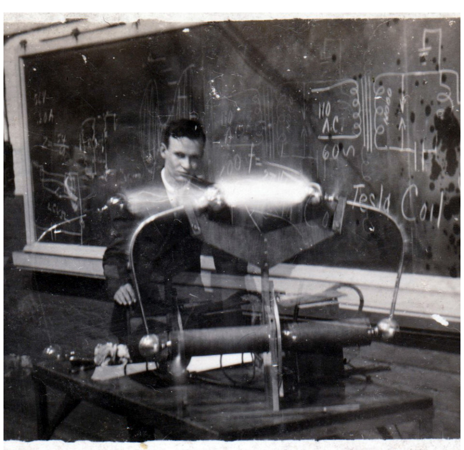
continued on page 4...

The Wisman Meteorite: A Tale of Engineering Genius and Philanthropy

By
Professor Alan J. Kaufman

View from the rim looking at the upturned strata on the walls and down at the floor of Meteor (also Barringer) Crater in northern Arizona. (Photo Credit: Richard Walker)

Some 50,000 years ago when wooly mammoths and giant ground sloths ambled across the western high plains, an iron-nickel meteor about 50 meters wide streaked across the skies of the Colorado Plateau, and made an enormous impression on what is currently northern Arizona. The force of impact left behind a hole over a kilometer across and 300 meters deep known today as Meteor Crater (also Barringer Crater). While most of the 50 meter wide Canyon Diablo meteorite – named after a nearby creek – vaporized when it hit the planet with the force of a 10 megaton bomb, small fragments with charred fusion crusts were buried deeply in the surrounding soils. Thanks to the invention of an early portable metal detector by a bright young engineering student at Ohio State University (OSU), many of these buried meteoritic treasures were discovered littered beneath the sun-cracked surface around the crater just before WWII, and through the generosity of his daughters, one of them was donated to the University of Maryland Geology Department this past year.



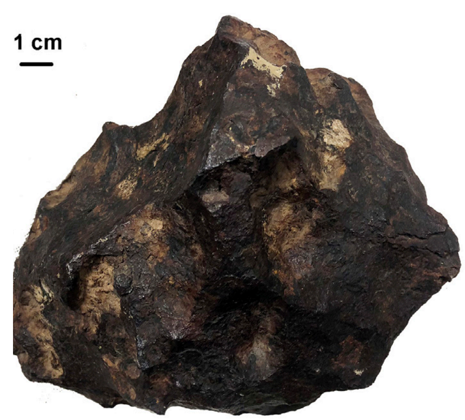
Franklin Wisman demonstrating a Tesla coil – a transformer circuit used to create high voltage and high frequency electricity – as an undergraduate student at Ohio State University.

The young genius was **Franklin O. Wisman** (pronounced Wiz-man) who in his sophomore year (1939) at OSU heard the famous pioneer of meteoritics, Professor **Lincoln LaPaz**, give a lecture on early attempts at metal detectors and his use of these unwieldy devices to uncover fragments of a similar iron-nickel meteorite that fell near Odessa, Texas. The resulting Odessa Crater has now mostly vanished due to erosion, unlike Meteor Crater, which still stands out on the Colorado Plateau and was originally hypothesized to be a volcanic edifice. According to sisters **Louise Lovell** and **Florence Mills**, their father and LaPaz worked together to engineer a metal detector with a novel magnetic field-generating design that could be carried in a backpack – and thus mobilize the search for meteorite fragments over rough terrain.

In LaPaz's popular science book titled Space Nomads: Meteorites in the SKY, FIELD, and LABORATORY, he described how the early meteorite detectors worked. He wrote:

"The essential principle on which it [the meteorite detector] operates is one familiar to any Boy or Girl Scout who has used a magnetic compass. The first lesson Scout-masters teach is not to read compass directions from such an instrument when it is held near a mass of iron of considerable size, such as an automobile. Such a large iron mass alters or distorts the local magnetic field of the earth on which the direction-finding ability of the ordinary compass depends. It is this very characteristic, so bothersome to the user of a compass, that is the principle on which meteorite detectors work. For if an electrically driven meteorite detector capable of generating its own magnetic field is carried over a deeply buried iron meteorite, the instrument's magnetic field will be distorted by the presence of the mfetal mass, just as the local magnetic field of the earth was distorted by the metal of the automobile."

The Wisman design worked so well that after it was tested at OSU, LaPaz and Wisman presented their results at the Eighth Meeting of the Meteoritical Society in Flagstaff, Arizona in 1941. It was at that meeting that LaPaz gifted the Canyon Diablo meteorite fragment to Franklin, who used it for decades as a heavy (~10 lbs.) yet unassuming door stop in the family home. While companion papers on the novel meteorite detector were published by LaPaz and Wisman in two 1942 issues of *Popular Astronomy*, the design – that would have worked better than modern metal detectors, but would have been more difficult to produce, according to Florence's husband **Pete Mills** – was never patented as the war



The fusion crust – a thin melted surface layer that formed on entry into Earth's atmosphere – on the Wisman Meteorite donated to the Geology Department.

effort focused all of Wisman's attention on the overseas conflict. He started his career at Bendix Aviation in South Bend, Indiana almost immediately after graduation and only months before the onset of WWII. At Bendix, Wisman worked with engineering teams to invent, engineer, and patent many systems for military aircraft, including an automatic machine gun charger and an aircraft engine synchronizer that allowed pilots to shoot their guns through spinning propellers. At some point in the war, the Allies had captured a Messerschmitt from the Germans, and it had been taken to Wright Patterson Army Airfield in nearby Dayton, Ohio for study. *"Dad was one of the engineers that was selected from Bendix,"* said Florence, *"and he said that the Messerschmitt was a piece of work. They were highly impressed by its technical details."* Louise interjected, *"Dad told me the airplane was so good, so technologically advanced that at the time, he thought we would not win the war!"* One could argue that this realization was the stimulus for Wisman and his technical team's subsequent aircraft inventions, which clearly matched German technological advances (it is notable that he was of German descent) and saved countless lives by shortening the war.

Newlyweds Franklin and Martha Wisman on the steps of their home in South Bend, Indiana.

In South Bend, Wisman also met his soon-to-be wife **Martha Rush** at a Sunday evening social gathering for young adults at the First Presbyterian Church. It turns out they met on Pearl Harbor Day, and according to Florence, instead of cancelling everything, and everyone going to their houses to listen to news on the radio, the social went on in the face of calamity. Franklin and Martha were married in June and they started their family in a house within walking distance of Bendix.

After WWII ended, Bendix shut down most of their military operations. Wisman changed companies to Dodge Manufacturing, also in South Bend, and worked on automotive systems, and subsequently patented many magnetic, electrical, and hydraulic systems, including brushes, clutches, solenoids, throttles, plugs, generators, and fuel injectors in the 1950s and 1960s. By the 1970s, however, Franklin and Martha returned to Frank's Appalachian roots (he was born in Cumberland, Maryland) and settled down in nearby Chambersburg, Pennsylvania. He was Chief of Engineering at T.B. Woods (now known as Altra Holdings, Inc.) in their Research & Development division for power control transmission systems. While there, he invented a high torque and synchronous belted drive system called the Ultracon, which quickly became the backbone of the company and replaced a substantial number of chain sprocket assembly systems in a wide range of food and manufacturing industries that required variable speed controls for assembly line processes. The motor controls systems that have come before the Ultracon had a myriad of operational amplifiers that led to repeated shutdown of assembly lines. In contrast, Pete said, *"This motor control, and he designed both the electronic and magnetic parts of it, had only one transistor, some other semiconductors, but no amplifiers in the whole thing! And the performance of it [the Ultracon] was better than those that had 10 amplifiers in them."* Starting from zero motor controls at T.B. Woods, Franklin told Pete that he thought the company produced about 1/3 of the entire US market after his invention.

Wisman was a hands-on engineer, and he would often install, or repair poorly installed systems, himself. *"What he was about as a person,"* Louise said, *"was in developing new products, like the motor control, but also about hands-on education. As a working engineer, he was really concerned that a lot of the young engineering graduates that would come by had such limited hands-on experience."* In addition to engineering research, Franklin was focused on continuing education across a broad spectrum of activities. He once read an article from an OSU alumni publication (probably similar to the Geogram) about a stock investment program in the Finance Department where the students were controlling a real portfolio. He thought this was a terrific learning experience, and given his own keen interest in the stock market, he endowed $10,000 of his own equities to establish the Wisman Fund to support a similar Investment Management Program at Shippensburg University of Pennsylvania, just 20 minutes down the road from Chambersburg. The investment program, which was founded in 1995, is exclusively managed by undergraduate students. The fund has been so successful that the College of Business has used the proceeds to provide scholarships to students majoring in finance at Shippensburg University.

Franklin O. Wisman died in 1997 with over 35 U.S. patents to his name. After his passing, the "doorstop meteorite" moved to Louise's home in Rockville, where it rested until the sisters donated the cosmic treasure to the Geology Department this past year. Wisman is remembered as a Renaissance man of engineering, the sciences, and the arts, as well as a keen businessman, preservationist, and world traveler. Because of their father's deep interest in both research and education, Louise and Florence wanted to donate the Canyon Diablo meteorite to an educational land-grant institution, like the University of Maryland and his alma mater, Ohio State University. *"It was a gift to Dad, and our father's interests were in research and education, so it occurred to us that gifting it to a university with dual*

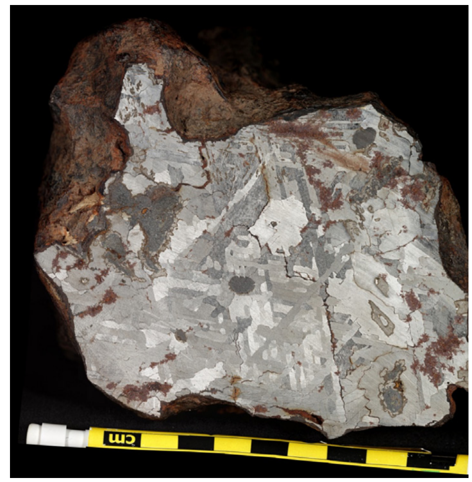
Franklin Wisman as the Chief of Engineering in the Research & Development division at T.B. Woods in Chambersburg, Pennsylvania.

Louise Lovell, Rich Walker, and Florence Mills holding the Wisman Meteorite in the Geology Department Mineral Museum. (Photo Credit: Todd Karwoski)

missions would give the meteorite important historical context," said Florence. Gifting specifically to the Geology Department is highly relevant insofar as the academic unit currently includes at least eight senior researchers and faculty cosmochemists who work on meteorites. Moreover, several Ph.D. dissertations have been based on measurements of the chemical and isotopic composition of other (very much smaller) fragments of the Canyon Diablo meteorite.

Rich Walker, Chair of the Geology Department and an award-winning (Harry Hess medal of the AGU and UMD Distinguished University Professor both in 2019) cosmochemist explained that recent research by his graduate student **Connor Hilton** and colleagues suggested that Canyon Diablo formed five to ten million years into solar system history, *"so it is a late comer"*. According to siderophile (iron-loving elements) abundance distributions, it appears that Canyon Diablo and its siblings formed by an impact melting process, he added, which is different than most iron-nickel meteorites that are thought to be from the cores of asteroids. Insofar as the meteorite's genetic/isotopic signature is identical to that of the Earth, Walker said, *"it's our closest-living relative, cosmochemically speaking."*

The charred fragment of the Canyon Diablo meteorite was cut, polished and etched with nitric acid at the Smithsonian Institution in order to expose the characteristic Widmanstätten pattern, which consist of long interweaved crystals of the iron-nickel minerals kamacite (with 5-10% Ni) and taenite (with 20-65% Ni). An ultra-high resolution GIGAmacro image (http://geol.umd.edu/canyondiablo) of the cut and etched meteorite surface was created to share the extra-terrestrial treasure on-line with the world. Furthermore, a display case specifically for the Wisman meteorite was assembled by a designer who has previously worked for the Smithsonian Institution. It was recently installed in the Geology Department Mineral Museum along with a plaque acknowledging Franklin Wisman and his daughters who made the donation to the Geology Department. Walker concluded, *"It is great having the first meteorite incorporated into our collection to be displayed in the Mineral Museum and used for public education for years to come, especially on Maryland Day."*



The cut, polished, and acid-etched surface of the Wisman Meteorite with its characteristic Widmanstätten pattern.

Letter from the Chair (Continued)

occur within the department! All of our 2020 promotion cases were successful. **Nick Schmerr** was promoted from Assistant to Associate Professor, **Richard Ash** was promoted from Associate Research Scientist to Research Scientist, and **Sarah Penniston-Dorland** was promoted from Associate Professor to Professor. Our faculty, postdocs and students continue to conduct and publish important research. I cite three examples of recent research that made the international news. A study published by **Tom Holtz** and colleagues in PLOS One found that Tyranosaurus rex's legs were built for endurance and efficiency, not just for speed. So it turns out that T. rex was not just another pretty face in the dinosaur world. In a study published in Science, postdoc **Doyeon Kim**, Associate Professor **Ved Lekic** and colleagues utilized a new machine-leaning algorithm to discover an ultralow-velocity zone near the core-mantle boundary beneath the Marquesas Islands. And if you have become bored with the Earth, in a Nature Geoscience article, **Laurent Montesi** and colleagues reported that some ring-like structures on Venus are probably still volcanically active.

As always, later in this Geogram you will find information about the many honors and awards received by members of our department in the past year. It has been a big year for us. To highlight a just a few, **James Farquhar** was named a Distinguished University Professor, **Mike Brown** was named AGU Fellow, Professor Emeritus **George Helz** was named Fellow of the AAAS, and Research Scientist **Igor Puchtel** was awarded the Provost's Excellence Award in recognition of his outstanding research. Our students also had a great year. For example, Ph.D. students **Kayleigh Harvey** and **Quancheng Huang** were awarded honors for work presented at the 2019 AGU meeting. Kayleigh was awarded the GeoPRISMS AGU Student Prize for best poster presentation and Quancheng received an Outstanding Student Presentation Award. Congratulations to all!

Unlike prior year, I won't encourage you to visit. Please stay away for at least the next few months! But do come visit when things return to normal. My term as Chair comes to an end in June, so this is my last Chair's letter. I've enjoyed serving as Chair the past five years (except for Covid!) but am ready to turn the reins over to my (as yet unnamed) successor.

Richard J. Walker

Research Focus

What are geoneutrinos and why study them?

By
Professor William McDonough

Who are we? Professionally, I am called a geologist, but often today I'm referred to as a geoneutrino scientist. Career changes come about in the strangest of ways. Fifteen years ago, sitting at home at the end of the day thinking about the remaining week's work when a phone call came in from a particle physicist in Hawai'i. *"I know what you did wrong with your calculations on the uncertainty"* said the caller on the other end. *"Also, I want to bring you to the University of Hawai'i to speak at a meeting we will have about geoneutrinos."*

The week before, I had finished a review of their paper submitted to Nature and these physicists wanted to help me fully understand their data and calculations. Initially, when asked by Nature to review the paper, I turned them down twice because I didn't really understand the topic nor what was being plotted in the figures. What in heavens is a geoneutrino and why do I care?

With a small group of graduate students, for the last 10 years, we have been building 3-D models that describe the crust and mantle abundances and distribution of potassium (K), thorium (Th), and uranium (U), the heat-producing elements, in order to predict the flux of geoneutrinos from the Earth. **Yu Huang** (PhD, 2013), **Meng Guo** (MSc, 2018), **Scott Wipperfurth** (PhD, 2019), and now **Laura Sammon** (4th year PhD candidate) have been integrating geochemical and geophysical data into a high spatial resolution, multi layered, computer models of the planet. In addition, they have also been learning a good amount of particle physics along the way, in order to understand both the science and detection technology.

Geoneutrinos are naturally occurring electron antineutrinos produced during $\beta-$ decay of the heat producing elements (i.e., K, Th and U). They are small, chargeless, and nearly massless ghost-like particles that are almost impossible to detect. Their interaction cross-sections are so small (i.e. 10^{-44} cm^2) that a neutrino can travel through a light year's length of lead with a 50% chance of getting out unscathed.

The Earth has been called a shining antineutrino star, as it emits 1025 antineutrinos per second. Despite this enormous flux of geoneutrinos, only about a dozen particles are captured each year by large underground detectors. The three counting detectors, in Japan, Italy, and Canada, are the size of 5-story office buildings built one to two km underground. Detecting the Earth's geoneutrino flux tells us directly about the amount of radiogenic heat inside the Earth.

Elements like K, Th and U undergo radioactive decay via different mechanisms, giving off different particles (i.e. β, and/or γ) and heat. This release of energy drives various dynamic Earth processes including plate tectonics, mantle convection, and the geodynamo, with the latter generating the protective magnetic shield surrounding the planet.

Laura Sammon (top) and Bill McDonough (bottom) enjoying the weekly geoneutrino meeting during the pandemic.

By quantifying the planet's geoneutrino flux we can establish precisely its composition and define the meteoritic building blocks used to construct the Earth. Having built a theoretical model of the Earth's composition, I realized that this neutrino technology was capable of telling us which of the competing chemical models of the Earth is the right one!

The Earth is a space vehicle carrying us along as it rotates on its axis, orbits the Sun, and together the solar system orbits the galaxy. Our planet rotates at 0.5 km/second, orbits the Sun at 30 km/s, and circles the galaxy every 230 million years at 230 km/s. As viewed from above the Sun's north pole, the uniformity of the planet's rotation and the solar system's counterclockwise prograde motion reveals that we are a product from a co-rotational, accreting gas-dust cloud.

Planets are built in the solar system's protoplanetary disc and are the residue of stellar accretion. When planets come off this assembly line, they begin their journey with their sole tank of operating fuel. The kinetic energy of accretion and the gravitational energy of core formation represent the Earth's primordial energy. Together this and its radiogenic energy fuels the Earth's engine. Understanding the composition of the Earth and the fuel that drives its dynamics are the primary goals of geoneutrino science.

Unfortunately, today we do not have a gauge to tell us how much fuel is left to drive the Earth's engine. By defining the amount of uranium and thorium inside the Earth, we are building a fuel gauge for the radiogenic energy supply. Once established, this insight will transform our understanding of the planet's thermal evolution and define the amount of fuel left to power Earth's dynamics.

Electron antineutrinos have other uses, too. Funding for my research has in part come from the US intelligence community. Nuclear reactors produce large amounts of electron antineutrinos during nuclear fission as they generate electricity. By independently measuring the emission of electron antineutrinos from nuclear reactors, we can see the burning process in the core of these power plants and also understand fundamental processes in nuclear physics. The total electron antineutrino spectrum has two components: one from the Earth and the other from reactors. In this way the geoneutrino signal is the background for the reactor spectrum. If we wish to watch another country's nuclear power generation, we must understand the Earth's contribution to the total electron antineutrino flux.

Graduate Student Highlight

Kristel Del Carmen Izquiredo

By
Professor Laurent Montesi

Kristel Izquierdo poses in front of the El Chorreadero waterfall, close to her hometown in Mexico. The waterfall is slightly more accessible that Kristel's study site, the deep interior of the Moon.

The email came as a huge surprise. Like most students, **Kristel Izquierdo** had applied to the American Geophysical Union Outstanding Student Presentation Award (OSPA) mostly to placate her advisers. The competition would bring more attention to the talk but the AGU meeting has so many great talks… But the email made it clear: Winner of the 2018 OSPA award, Planetary Science section, Kristel Izquierdo! *"My goal was to get people excited about my work and to have a little fun during the talk. I thought I did a good job, but I was still very surprised when I received an email saying I had gotten the award,"* Kristel told me. A veteran of several oral and poster presentations, Kristel had managed to communicate the excitement and originality of her research to a tough crowd.

The path that Kristel took to achieve this recognition has not been a standard one. She joined the Department of Geology having studied Engineering Physics at the Tecnológico de Monterrey without taking a single class in Earth Sciences! Catching up on geosciences would be a challenge, but her understanding of physics and mathematics was unparalleled among graduate student applicants. In a way, Geology is the study of the Earth and geologists bring a wide variety of skills to that study. Physics is one of these. It is a passion for the Earth that makes a geologist, and Kristel has that in her blood. Born and raised in Tabasco, an oil-rich state in Mexico, she was introduced early on to the possibility of working as a geophysicist in the oil industry. She knew that studying physics would open this kind of career to her, and she was now ready to apply her skills to geosciences.

Once in Maryland, Kristel again took the path less trodden when selecting the topic of her thesis. She could have chosen the safer way, modeling lithospheric deformation, as I, her advisor, had often done. Instead, she became interested in a rather risky proposition: develop a brand-new gravity inversion method for application to planetary sciences, supervised jointly by Dr. Ved Lekic and me. I had never worked on gravity inversion and the inversion framework developed by Ved was designed for seismic inversions, not the analysis of gravity fields. There was a chance that this would never lead anywhere.

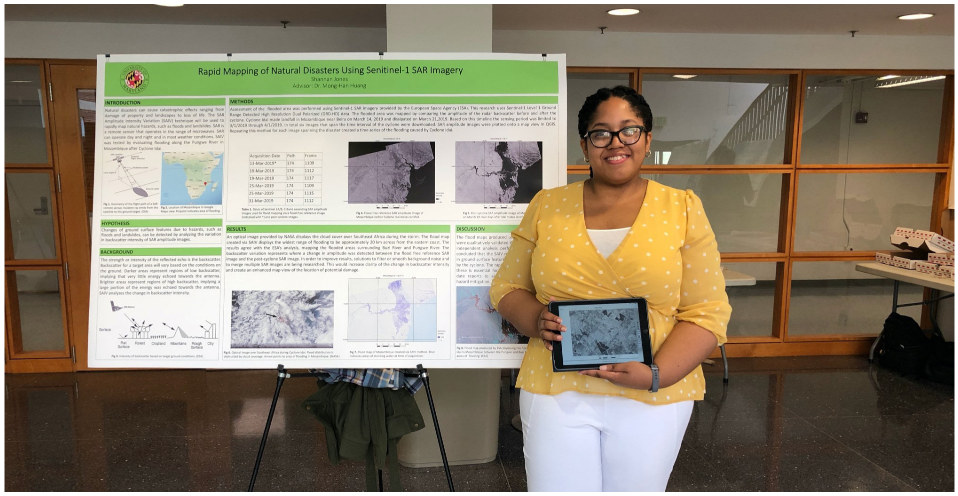
Kristel took the project and ran with it. She knew her expertise in mathematics and programming would be an asset, and she could learn enough about the interior and geology of the Moon to interpret the inversion results. Kristel immediately understood her work would make it possible, for the first time, to characterize the non-uniqueness of the interior structures deduced from gravity inversion. That objective was criticized by several community members who would prefer clear answers, such as specific values of crustal thickness, over a complex (but more complete) ensemble of solutions that are compatible with observations. Some did not hesitate to tell Kristel that her project was not worth it. But she persevered. She showed what can, and what cannot be constrained from gravity data. At AGU, the audience recognized the importance of her work and the quality of her presentation. Since then, she has shown that yes, we can tell something about the deeper mantle of the Moon, not just its crust. And now, with not one but three functional inversion codes, she has detected the first hints of low-density anomalies deep in the lunar mantle.

Kristel's resiliency comes from her spirit, her ever-present smile, and strong support from her family (and dogs). She has also been hardened by often being the odd one out. It was intimidating to be a physicist joining a geology program. As she recalls, *"I felt a little insecure when discussing Earth Science papers with faculty and other students because I was afraid I would say something that was obviously wrong."* Earlier, she had been one of very few female students in physics. Now, things were even worse. After a major conference, Kristel told me, *"I thought I had learned to deal with that but the lack of diversity in planetary science still got to me."* She worried that her opportunities as a non-US citizen would be limited. Over time, though, she found other minority students and professors, and she learned she could apply to work in many institutions, even NASA centers. After graduating, she will join the young and vibrant planetary science group at Purdue University, *"the postdoc I really wanted"*, as she writes. As the year 2020 inspires us to reflect on the experience of minorities, we should all ponder the message from this young talented woman that *"the lack of diversity is a big issue in planetary sciences"*. We are fortunate that Kristel chose geophysics, chose Maryland, and chose to work toward revolutionizing planetary sciences. We look forward to following her continued growth as a geophysicist and a role model for Latinx students.

Undergraduate Student Highlight

Shannan Jones

By
Assistant Professor Mong-Han Huang



Shannan Jones presenting her GEOL394 (senior thesis) research poster in May, 2019.

In **Shannan Jones'** early years, she had a natural curiosity as a child and developed an interest in physical science. Shannan's father is a carpenter, so she also grew up visiting construction sites. As a result, when she attended University of Maryland for the undergraduate program, Shannan expressed her breadth of interests by studying science, engineering, and architecture.

As a first-generation college student, college education feels like a privilege to Shannan. Raised by a single father and with financial burden, for a long time Shannan did not think she would be able to complete her undergraduate education. Initially majoring in Physics, Shannan found it challenging to focus on her education while working on two jobs and taking care of her father who was unwell. The university suggested a break, so she could take care of her own health and get affairs in order. Shannan remained dedicated to her academic pursuits, and after a brief hiatus, she returned to school to complete her degree.

Encouraged by her physics faculty mentor Professor **Dan Lathrop** (also affiliated with the Department of Geology) as well as the director of Undergraduate Studies in Geology, **Dr. John Merck**, Shannan decided to switch her major to Geology. She immediately found that geology is a field full of opportunities, where she can apply her background in physics to multiple applications. She was particularly interested in Geomorphology taught by Associate Professor **Karen Prestegaard** and Structural Geology taught by me. She started to develop a research interest in hillslope stability and natural hazard mitigation. When it was time to choose her research advisor and senior thesis project, Shannan came to me with some great ideas. We quickly found a neat research topic that combined both our interests: using remote sensing tools to locate and map natural hazards.

In her senior thesis research, Shannan utilized a specific kind of remote sensing data – Synthetic Aperture Radar (SAR), to monitor change of surface feature due to floods and landslides. Although satellite-based optical sensors can provide better quality and accuracy, they can only be operated in day times and cannot see through clouds, which are common after major rainstorms, especially in tropical countries. SAR sensors, on the other hand, can see through clouds and are operational both in day and night times. This method works as it calculates change of SAR backscatter intensity before and after an event, which is normally caused by addition of water on ground surface (e.g. flood) or removal of material on hillslopes (e.g. landslides). Shannan applied the SAR method to the floods in Mozambique in March 2019 and a major landslide event caused by the Brumadinho Dam Collapse in Brazil in January 2019. She found a relationship between detection quality and number of pre/post-event stacks. Based on her outstanding achievements in undergraduate work, Shannan received the Marc Lipella Memorial Scholarship in 2019 and the Department of Geology Field Camp Scholarship. She was also a recipient of the GSA COVID-19 Assistance and Relief Effort for Students (CARES) grant in 2020 to support field camp study.

In Shannan's senior year, she started to see a career path as a scientist. Shannan and I started to discuss the opportunity of pursuing a Master's degree in our department. Shannan is currently a first-year graduate student. We collaborate with Assistant Research Professor **Hannah Kerner** in the Department of Geography at UMD, **Dr. Alexander Handwerger** at NASA Jet Propulsion Laboratory, and **Dr. Dalia Kirschbaum** and **Dr. Pukar Amatya** at NASA Goddard Space Flight Center. We currently use the concept based on Shannan's senior thesis to identify rainfall triggered landslides following a typhoon in Hiroshima, Japan in 2018. This work is currently under peer review. In the near future, we will apply this method to wildfire mapping in Australia with Assistant Professor **Katherine Bermingham** at Rutgers University, who was inspired to study this topic after seeing Shannan's senior thesis presentation. Recently we received a Graduate School Faculty-Student Research Award, to support Shannan's field work in Australia in the near future.

In addition to research, Shannan is also passionate about improving diversity, equity, and inclusion (DEI) in Geosciences. Shannan took courses in fundamentals of Feminist Theory and Critical Race Theory, and she also obtained an Upper Division Certificate in Women's Studies. She has been playing an essential role in the inclusivity, diversity, and equity awareness (IDEA) committee in our department. Her research was recently featured in the Black In Geoscience (BIG) week.

In the future, Shannan wants to work with organizations such as FEMA or being a professor in Geosciences. I am very proud to be her advisor and have the opportunity to work with such a self-motivated student. I was deeply moved when she told me she has never had a Black TA growing up. But now she is the TA leading laboratories in Principles of Sedimentation and Stratigraphy, and on the way to a stellar career in science.

Recognition & Awards

Faculty & Staff

In 2020 we saw three faculty members receive promotions. **Richard Ash** was promoted from Associate Research Scientist to Research Scientist. **Nicholas Schmerr** was promoted from Assistant Professor to Associate Professor. **Sarah Penniston-Dorland** was promoted from Associate Professor to Professor.

Michael Brown was named Fellow of the AGU (American Geophysical Union).

George Helz was named Fellow of the AAAS (American Association for the Advancement of Science).

Igor Puchtel was named a 2019-2020 Provost's Excellence Award for professional track faculty in recognition of his outstanding research.

James Farquhar received the title of Distinguished University Professor.

Alan J. Kaufman received a 2019 Fulbright Foundation Global Scholar Award based on his research on the origin of seashells.

Wenlu Zhu was awarded the Louis Néel Medal of the European Geosciences Union (European Geosciences Union - EGU) in recognition of her outstanding achievements in rock physics and geomechanics.

Dan Lathrop (Geology & Physics) was a 2019 winner of the UMD Distinguished Scholar-Teacher Award.

Students

Grad Talk (2020): PhD candidate: **Connor Hilton** *(Advisor: Walker),* PhD pre-candidate: **Ziqin "Grace" Ni** *(Advisor: Arevalo),* MS student: **Rumya Ravi** *(Advisor: Prestegaard).*

Grad Paper (2020): Kayleigh Harvey *(Advisor: Penniston-Dorland)* for her paper titled "Assessing *P-T* variability in mélange blocks from the Catalina Schist: Is there differential movement at the subduction interface?" published in the Journal of Metamorphic Geology.

Andrew Doerrler, Julianne Farnham, **Joseph Malin, Adam Margolis**, **Madeline Raith** and **Sophia Zipparo** are the 2020 recipients of the Marc Lipella Memorial Scholarship.

William Hoover *(Advisor: Penniston-Dorland)*, **Karen Pearson** *(Advisor: Lekic)* and **Rumya Ravi** (*Advisor: Prestegaard)* are the 2020-21 Green Fellowship in Global Climate Change awardees.

Alexis Yaculak is the 2020-21 Green Scholarships in Environmental Science and Restoration awardee.

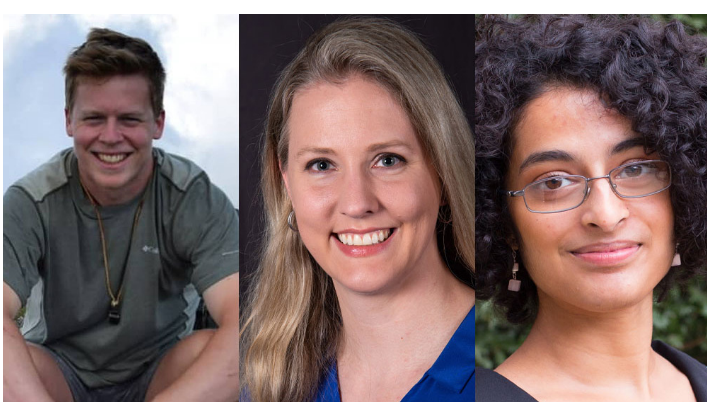
Samuel Crossley *(Advisors: Ash, Sunshine)* and **Connor Hilton** *(Advisor: Walker)* have each been awarded an Ann G. Wylie Dissertation Fellowships for a semester during the 2020-2021 academic year.

Kayleigh Harvey *(Advisor: Penniston-Dorland)* has been awarded the 2019 GeoPRISMS AGU Student Prize.

Quancheng Huang *(Advisor: Schmerr)* received an Outstanding Student Presentation Award for his presentation at the AGU Fall Meeting in San Francisco December 2019.

Adam Margolis received a CMNS Alumni Network Undergraduate Summer Research, Travel and Educational Enrichment Award.

Lori Willhite *(Advisor: Arevalo)* was selected for a two-year term as one of the Geological Society of America Planetary Geology Division student representatives and student advisor on the GSA Student Advisory Committee.



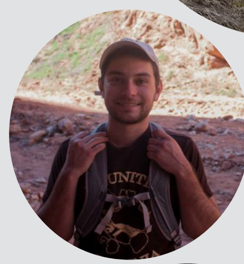
2020-21 Green Fellowship in Global Climate change award winnners.
(L-R) William Hoover, Karen Pearson and Rumya Ravi.

2020-21 Ann G. Wylie Dissertation Fellowship awards winners.
(L-R) Connor Hilton and Samuel Crossley.

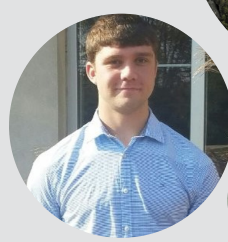
Congratulations to our recent graduates!












Doctoral Graduates

James W. Dottin, III. Sulfur Isotope Characterization Of Mantle Reservoirs Sampled By Ocean Island Basalts, *Advisor: Farquhar,* Spring 2020.

Austin Gion. The Geochemical Behavior Of Scandium During Fractional Crystallization And Implications For Ore Formation, *Advisor: Candela/Piccoli,* Summer 2020.

Kayleigh Harvey. Petrologic and Geochronologic Constraints on the Thermal Structural Evolution of Paleo-Subduction Interfaces, *Advisor: Penniston-Dorland,* Summer 2020.

Kristel Izquierdo. Inference Of Mass Anomalies In Planetary Interiors Using A Bayesian Global Gravity Field Inversion, *Advisor: Montesi, Spring* 2021.

Connor Hilton. Genetics, Ages and Chemical Compositions of Ion Meteroites, *Advisor: Walker,* Fall 2020.

Quancheng Huang. Investigating the Internal Structure of Earth and Mars With Seismic Body Waves, *Advisor: Schmerr,* Fall 2020.

Angela Marusiak. Planetary Seismology using Single-Station and Small-Aperture Arrays: Implications for Mars and Ocean Worlds, *Advisor: Schmerr,* Summer 2020.

Joseph Schools. Dynamic Melt Processes in the Lithospheres of Mars and Io, *Advisor: Montesi,* Summer 2020.

Masters Graduates

James Bader. Characterizing 3-dimensional Melt Distribution and Anisotropic Permeability in Sheared Partially Molten Rocks, *Advisor: Zhu,* Summer 2020.

Tracey Centorbi. Re-Os And Oxygen Systematics Of Variably Altered Ultramafic Rocks, North Carolina, *Advisor: Walker,* Summer 2020.

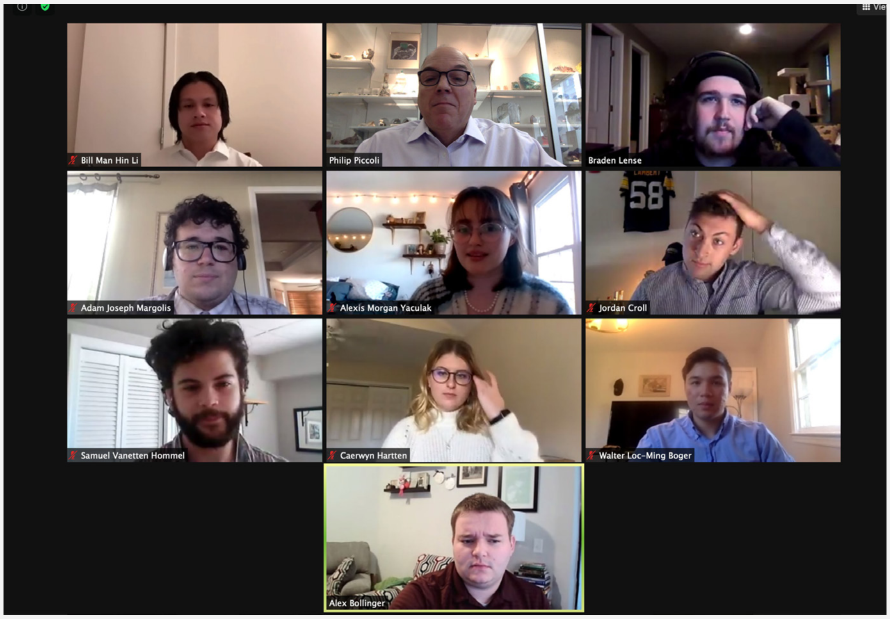
Carol Morel. Developing Sensor Proxies for "Chemical Cocktails" of Trace Metals in Urban Streams *Advisor: Kaushal,* Summer 2020.

Haley Talbot-Wendlandt. Warm Season Hydrological Processes in a Boreal Forest Hillslope and Catchment, Newfoundland, *Advisor: Prestegaard,* Summer 2020.

Hope Tornabene. Insights to the Genetics, Age and Crystallization of Group IC and IIC Iron Meteorites, *Advisor: Walker,* Summer 2020.

Kelsey Wood. Tree Trade-Offs in Stream Restoration: Impact on Riparian Groundwater Quality, *Advisor: Kaushal,* Fall 2020.

Zachary Zega. Brittle Faulting in Porous, Water-Saturated Sandstone Deformed under High Pore Fluid Pressure, *Advisor: Zhu,* Summer 2020.



393/394 Final Presentation via Zoom. Top Row (L-R) Bill Li, Philip Piccoli, Braden Lense; Second Row (L-R) Adam Margolis, Alexis Yaculak, Jordan Croll; Third Row (L-R) Samuel Hommel, Caerwyn Hartten, Walter Boger; Bottom Row: Alex Bollinger.

Senior Thesis

The Department of Geology senior thesis program, coordinated by **Phil Piccoli,** has been a fixture of the Department of Geology since 1972. Senior thesis posters have enhanced the program since 2003; these represent one of the four presentations associated with the long established program, which is used as a model of success across campus. We wish each of our departing students – our newest alumni! – the best of luck in their future endeavors.

Aisin, Jacob. Using Seismic Surveys to Study the Subterranean Structures at the Paint Branch Floodplain. *(Advisor: Huang)*; **Becker, William**. Urban and Non-Urban Stream Channel Dynamics and Morphology for Chesapeake Bay Tributaries: The Influence of Urbanization on the Velocity of Water in the Channel Component of Lag Time. *(Advisor: Prestegaard)*; **Britton, Kenneth.** Analysis of Snowmelt and Autumn Storm Events Along a Newfoundland and Labrador Boreal Ecosystem Longitudinal Transect. *(Advisor: Prestegaard)*; **Cacopardo, Ari.** A Statistical Analysis of the Capabilities of LA-ICPMS as a Prospective Geochronology Instrument for Rb-Sr dating. *(Advisors: Arevalo, Ash, McDonough)*; **Chaudhary, Sona.** Metasomatism in Monviso Metagabbros: Birth of the Reaction Rind. *(Advisors: Penniston-Dorland, Hoover)*; **Culbreth, Nicholas.** Constraining Magma Ascent Rate Using Water Diffusion in Olivine and Clinopyroxene — Mt Pavlof, Alaska. *(Advisor: Newcombe)*; **Douglas, Jared.** Effects of Reservoir Storage on Streamflow in Western Cape, South Africa. *(Advisor: Prestegaard)*; **Emm, Nicholas**. Chemical Effects of Metamorphism on Enstatite Chondrites. *(Advisor: Ash)*; **Fernandes, Ashely.** Ediacaran Reef Construction and the Earliest Evidence for Animal Biomineralization. *(Advisor: Kaufman)*; **Harper, Ian.** Distribution of I-, S- and A-Type Granites in the Eastern United States. *(Advisors: Piccoli, Gion)*; **Ho, Cristy.** Conditions of Mélange Diapir Formation. *(Advisors: Penniston-Dorland, Harvey, Montesi);* **Houston, Andrew.** The Mount Pleasant Ore System: Result of A-type or Topaz-Rhyolite Magmatism? *(Advisors: Piccoli, Gion, Ash)*; **Jenkins-Houk, Orion.** Environmental and Ecological Factors Affecting the Presence of Giant Land Turtles in the Late Cenozoic. *(Advisor: Holtz)*; **Jones, Shannan.** Rapid Mapping of Natural Disasters using SAR Imagery from Sentinel-1 Satellites. *(Advisor: Huang)*; **Nehring, Adaire.** Quantifying the Effects of Shear Strain on Melt Distribution and Permeability. *(Advisors: Zhu, Bader)*; **Nguyen, William.** The Influence of Road Salts on the Mobilization of Bioreactive Elements in Regenerative Stormwater Conveyance Systems. (*Advisor: Kaushal)*; **Terzic, Dario.** Evaluating Hydraulic and Vegetative Effects on River Bank Erosion. *(Advisor: Prestegaard)*; **Volz, Samantha.** Effects of Soil Characteristics on Evapotranspiration-Driven Water Table Decline and Recovery in a Forested Floodplain. *(Advisors: Prestegaard, Talbot-Wendlandt)*; **Wollney, Jenna.** The Relationship Between Past Radiative Forcings and ENSO Activity. *(Advisor: Evans)*; **Zheng, Zexing.** Investigating Oxygen Fugacity Changes as Results of Subduction Metamorphism and Metasomatism. *(Advisor: Penniston-Dorland, Hoover, Harvey)*.

To see the posters from this year's presentations and lists of theses over the past 40 years go to http://www.geol.umd.edu/seniorthesis.

Thank you to our *annual fund* donors!

We are grateful for the generosity and continued commitment of our donors during the past several years, and we salute those of you who make annual gifts to support the department. We acknowledge the importance of each contribution in support of our education and research missions. Making available opportunities for students to be involved in the excitement of advancing knowledge is critical to the development of the next generation of scientists who will solve problems of societal relevance. In addition, for many of our undergraduates our ability to help with the costs of field camp and senior thesis research is critical to their success.

Your generosity benefits our students in many ways. Therefore, once again, we ask for your support. Tax-deductible gifts to the department can be made online through the UMCP Foundation website:

Enter http://go.umd.edu/geologyannualfund in your browser's address field to be taken directly to the Geology Department's gift giving site. We've also enclosed a postage-paid return envelope for check or cash gifts. If you are writing a check, please be sure to include "Geology Department Endowment" or "Geology Operating Account" in the notes section to ensure that your funds are allocated properly.

BENEFACTORS

December 1, 2019 to November 30, 2020

Up to $99 per year

Richard Ash
David B. Erbb
Robert B. Finkelman
Christy A. Hoover
B. Suzanne Martin
Sarah C. Penniston-Dorland
Valentina A. Puchtel
Nicholas C. Schmerr
John P. Varndell and
Billie J. Varndell
Marc I. Yalom

Up to $100 - $249 per year

Ricardo D. Arevalo, Jr.
Michael N. Evans
John H. Fournelle
Allison Gale
Robert M. Glazier
Alan J. Kaufman
Andrew L. Masterson and
Julia Masterson
Gregory C. Ohlmacher
Alicia W. Siegrist and
Henry G. Siegrist
Barrett L. Smith
Robert L. Virta

$250 and above per year

Michael Brown and
Jennifer F. Brown
Steven L. Goldstein
David R. Grogan and
Denise A. Grogan
Margaret A. Karwoski
Carol Kendall
Philip M. Piccoli and
Anne M. Piccoli
Adam Charles Simon and
Alicia Denise Simon
Fang-Zhen Teng and
Jianying Wang
Lynn Wang and
Chihsien Chen
Richard J. Walker and
Mary F. Horan
Ann G. Wylie
Wenlu Zhu and
Laurent Montesi

COLLEGE OF
COMPUTER, MATHEMATICAL
& NATURAL SCIENCES

Department of Geology
8000 Regents Drive
University of Maryland
College Park, MD 20742

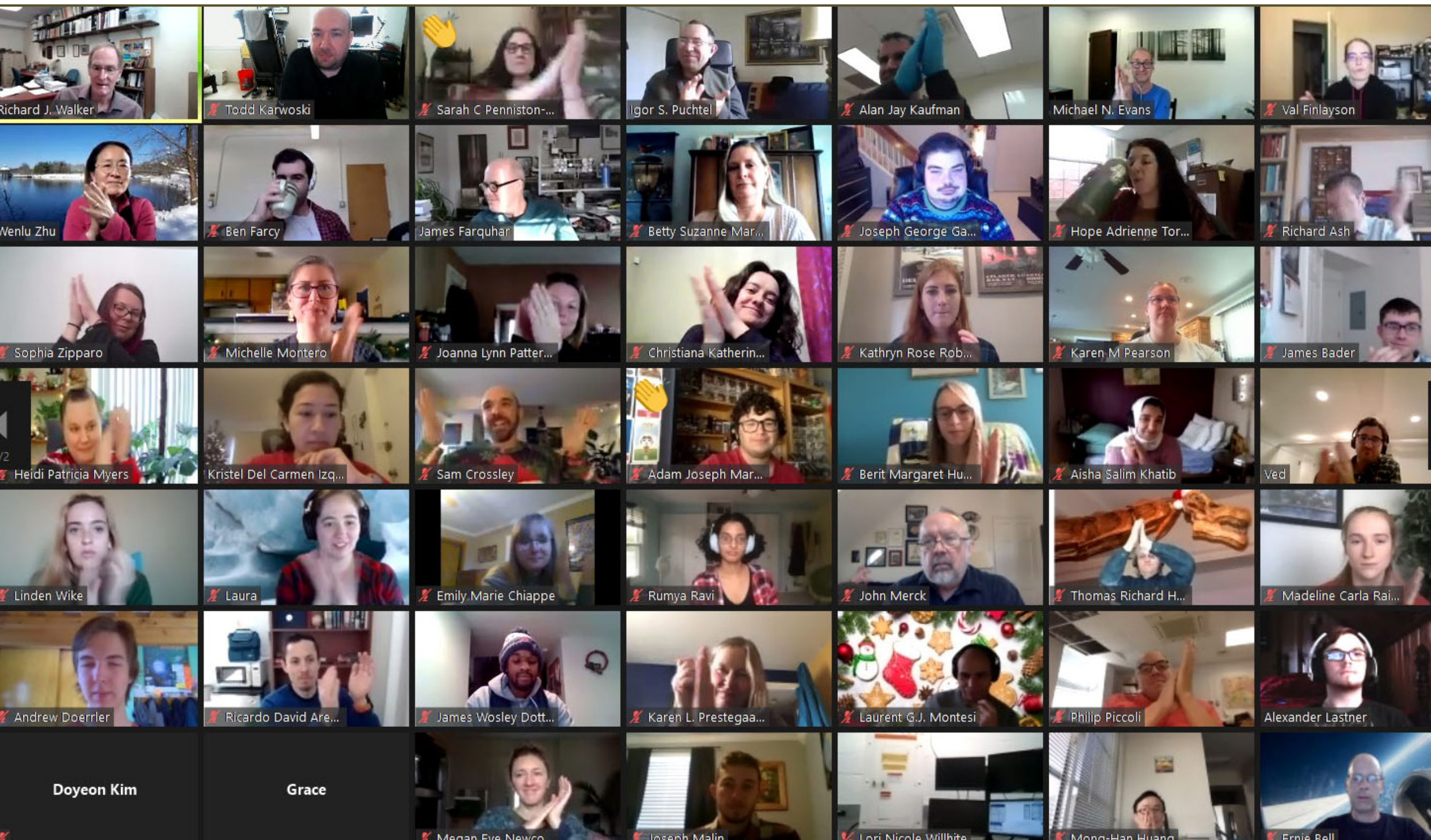


Photo Credit: Todd Karwoski

Contact us

Department of Geology
8000 Regents Drive
University of Maryland
College Park, MD 20742

301-405-4082 (p)
301-314-9661 (f)
geology@umd.edu

www.geol.umd.edu

GeoGram *is an annual publication of the University of Maryland, Department of Geology. We welcome your comments and feedback.*

For address changes and personal updates, please visit www.geol.umd.edu/alum-reg

Acknowledgments: We would like to acknowledge Todd Karwoski for his photography which appears throughout this issue and Michelle Montero for her work on this year's GeoGram.