

UCLA

**Earth, Planetary,
and Space Sciences**

Fall 2017 Newsletter



Greetings from the Chair

I am excited to present the Fall 2017 newsletter. It includes reports on our accomplishments this past year, including exciting science results (e.g., pages 4 and 16), new instructional initiatives (page 3), and impactful outreach events (e.g., pages 5 and 15). EPSS enabled thousands of eager observers to enjoy the Great American Eclipse on August 21, 2017 (pages 12–14). EPSS once again co-hosted the Exploring Your Universe science festival that welcomes thousands of people to campus each year (pages 8 and 9).



I am pleased to report that the generosity of our friends and alumni has enabled several important initiatives that we would not otherwise be able to support with state or tuition funds. The research experiences for EPSS undergraduates have been quite successful (page 17) and we have implemented an annual call for proposals to incentivize additional research. At the moment, our endowed funds allow us to support a few research experiences per year. We have also established new graduate student awards. An extramural fellowship award rewards students who have been successful in securing multi-year funding from an extramural agency (e.g., NASA, NSF) and an outreach award will reward students who have been particularly active in furthering the Department's outreach mission. In order to increase EPSS's stature, we have increased our budget for colloquia and seminars by 75% and we will bring intellectual leaders to campus to share with them the impressive work that we do. A special seminar by modern-day Copernicus Bill Borucki (page 15) and a field trip to Meteor Crater (page 3) were both enabled by a generous donor. Finally, we have taken the first steps towards renovating our Commons Room, which is a space that our students use to study, socialize, and relax. We will start with a new floor, ceiling, and furniture, but we have greater ambitions for this beloved space.

We value your involvement with EPSS. If you would like to partner with us on some of our initiatives, including named colloquium series, endowed student awards, funds for outreach or field trips, or other projects, please reach out to me at chair@epss.ucla.edu or 310.825.1475. For a limited time, we are able to secure 1-to-1 or even 2-to-1 matching contributions for qualifying gifts (page 22).

I hope our alumni will enjoy the newly redesigned alumni page on the EPSS website. The section describing the professional outcomes of our alumni gives us great pride, and we have now added an astronaut candidate to our list (page 3). I encourage you to network with our many talented alumni and let me know about your endeavors and accomplishments.

Warm regards,
Jean-Luc Margot

A handwritten signature in black ink that reads "JLMargot".

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Chair

Jean-Luc Margot
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Hilda Avanesian and JLM

Front Cover

Participants of our solar eclipse trips were treated to a beautiful sight (page 14).

Photo credit: Craig Seidel

Center Spread

The Great American Eclipse

Back Cover

Students explore Fossil Falls during Summer Field 2017.

EPSS Graduate Jessica Watkins Selected for 2017 NASA Astronaut Class

Former EPSS graduate student Jessica Watkins (Ph.D. 2015) has been selected by NASA to join the 2017 Astronaut Class. Jessica was one of 12 candidates selected among more than 18,300 applicants. At UCLA, Jessica used orbital data analysis and field research to study the emplacement mechanisms of landslides on Mars and Earth, and the formation of seasonal slope features on Mars. Her Ph.D. dissertation, written under the guidance of Professor An Yin, is titled "Tectonic and Aqueous Processes in the Formation of Mass-wasting Features on Mars and Earth." Jessica was a recipient of the Harold and Mayla Sullwold Scholarship for Academic Excellence and Outstanding Original Research in EPSS. She was also awarded a National Science Foundation Graduate Research Fellowship in Geosciences. She will train for two years as an astronaut candidate, after which she will work in the Astronaut Office until she receives a flight assignment. We wish her the very best and look forward to seeing another Bruin in space.



Photo credit: NASA.

A Day Trip to Meteor Crater by David Paige

Meteor Crater in Arizona is one of the best-preserved major impact events on Earth. Impact craters are common on planetary surfaces throughout the Solar System, but on Earth, the shielding effect of our atmosphere plus the effects of tectonics and erosion make them a rarity. This November, a generous gift from Michael Thacher and Rhonda Rundle made it possible for undergraduates in our Planetary Physics (EPSS 155) class to have an opportunity to take a one-day field trip to visit the crater and learn about planetary cratering processes and their effects on the environment. The students discovered fragments of the ~50-meter diameter nickel-iron meteorite that impacted the Colorado Plateau ~50,000 years ago and learned first hand about this important and universal planetary geological process.



Photo credit: Kevin McKeegan.

Titan Storms

by Sean Faulk and Jonathan Mitchell

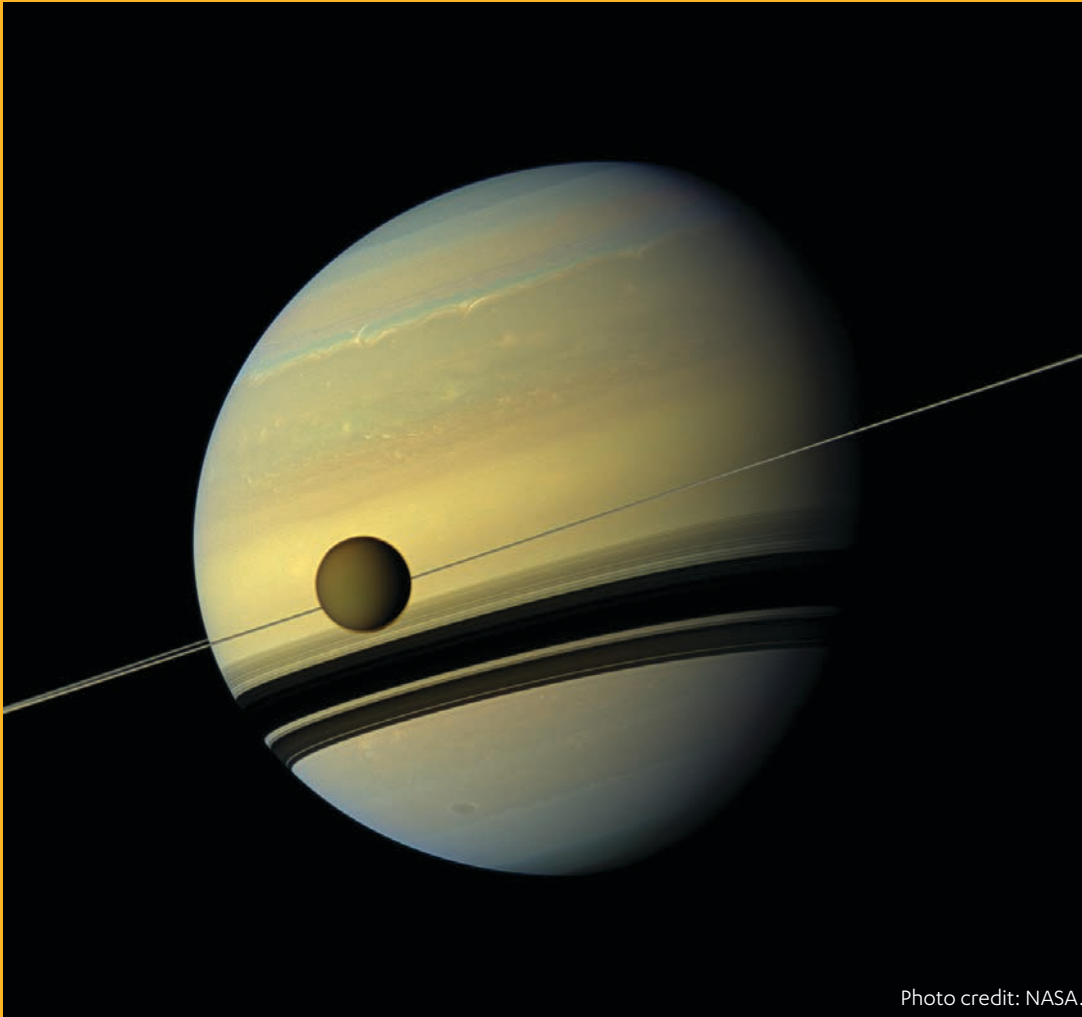


Photo credit: NASA.

Over the course of its nearly two-decade tour of Saturn, NASA's Cassini spacecraft showed us that Titan, Saturn's largest moon, is a world with a hydrologic cycle very much like our own, where methane evaporates, condenses, and interacts with the surface. Observations revealed methane storm clouds and river channels at virtually all latitudes, while vast lakes and seas exist only near Titan's poles. Fluvial erosion and surface transport are also evident; the European Space Agency's Huygens lander found rounded pebbles in an equatorial dry lakebed while Cassini's radar instrument observed alluvial fans, cone-shaped

surface features formed by sediment flows during intense rainstorms. But while climate models of Titan's atmosphere have successfully reproduced the distribution of clouds over a typical Titan year, as well as the collection of surface liquid methane at the poles, no previous studies have investigated the behavior of extreme rainfall events that might be capable of triggering major sediment transport and erosion like those implied by Titan's alluvial fans. In an October 2017 article in *Nature Geoscience*, EPSS graduate student Sean Faulk, Professors Jonathan Mitchell and Seulgi Moon, and postdoc Juan Lora analyzed a 50-Titan-year climate simulation, focusing specifically on the magnitudes and locations of individual rainstorms. The results are astounding—whereas Titan's typical methane rain is a light drizzle, the most intense storms dump feet of rain in a single day, about as much as Houston, Texas received during Hurricane Harvey. Even more surprising is that these superstorms are relatively common, occurring every few decades rather than the millennia suggested by simple physical analysis of Titan's cold climate. But the clincher is that the storms preferentially occur in Titan's mid-latitudes, around 60 degrees in each hemisphere, exactly the latitudinal region where observed alluvial fans are most heavily concentrated. This correlation suggests that Titan's alluvial fans were formed (as they are on Earth) during intense rainstorms, demonstrating the essential role that climate plays in shaping Titan's surface. A lesson learned from Faulk et al. is that erosion occurs on any planetary body with a hydrologic cycle—past or present, water- or methane-based—rendering planetary surfaces as records of their climate history, and broadening our understanding of the impacts of climate changes on Earth and our neighboring planetary bodies.

Distinguished Alumni and Faculty Lectures

This year's distinguished alumni lecture was given by Cassini Project Scientist Dr. Linda Spilker (JPL). Dr. Spilker earned her Ph.D. from UCLA in Geophysics and Space Physics in 1992 under the guidance of Professor Chris Russell. More than 190 guests attended her talk titled "Cassini at Saturn" on October 26, 2017, a few weeks after the dramatic end of the Cassini mission. The Cassini mission has been one of the most successful NASA missions ever launched. During two-thirds of its 20-year lifetime, the Cassini spacecraft surveyed the planet Saturn and its majestic system of rings and satellites. Cassini probed Saturn's atmosphere, interior structure, and magnetic field. It illuminated the elaborate dance among moons and ring particles. It revealed the lakes and rivers of Titan and the subsurface ocean and geysers of Enceladus, two satellites with potentially habitable environments. During the Grand Finale phase of the mission, the spacecraft made daring close flybys between the atmosphere and inner ring before impacting the planet. Dr. Spilker eloquently described Cassini discoveries and results while weaving in fond memories of her time at UCLA. She also described how working with Cassini scientists felt like having a second family. Her talk was very well received by both scientists and non-scientists. A panel discussion with Dr. Spilker, Professor Russell, EPSS researcher Krishan Khurana, and EPSS graduate student Sean Faulk addressed audience questions and concluded the event.

We experimented with an original format for this year's EPSS faculty lecture, which was held on May 9, 2017, at the Fowler Museum's Lenart Auditorium. The event was titled "It Fell From The Sky" and featured a catered outdoor reception in the museum's amphitheater, meteorite displays, a panel discussion with meteorite collectors and researchers, and a talk by Professor Emeritus John Wasson, chief curator of the UCLA Meteorite Gallery. About 130 guests attended the event, including several members of the Meteorite Collection Advisory Board. Guests had a chance to hold and examine 4.6-billion-year-old rocks that fell from the sky and address questions to meteorite experts Dr. Alan Rubin and Dr. Nick Gessler. Professor Wasson shared the captivating story of the recovery of the Treysa meteorite, which fell over 100 years ago in Hesse, Germany. A panel with Professor Wasson, meteorite collector Peter Utas, meteorite collector and artist Arlene Schlazer, EPSS researcher Dr. Rubin, and EPSS graduate student Kaitlyn McCain discussed the importance of meteorite studies and the UCLA meteorite collection. The evening concluded with audience questions and a visit to the UCLA Meteorite Gallery with many enthusiastic guests.



Young attendees got hands-on lessons about meteorites prior to Professor John Wasson's talk. Photo credit: Mojghan Haghnegahdar.



The panel discussion at the EPSS faculty lecture: Professor John Wasson, Peter Utas, Arlene Schlazer, Professor Jean-Luc Margot, Kaitlyn McCain, and Dr. Alan Rubin. Photo credit: Mojghan Haghnegahdar.



Alumni and friends enjoyed a reception in the lobby of the California Nano-systems Institute prior to Dr. Linda Spilker's talk. Photo credit: Lisa Garibay.

New Faculty: Mackenzie Day

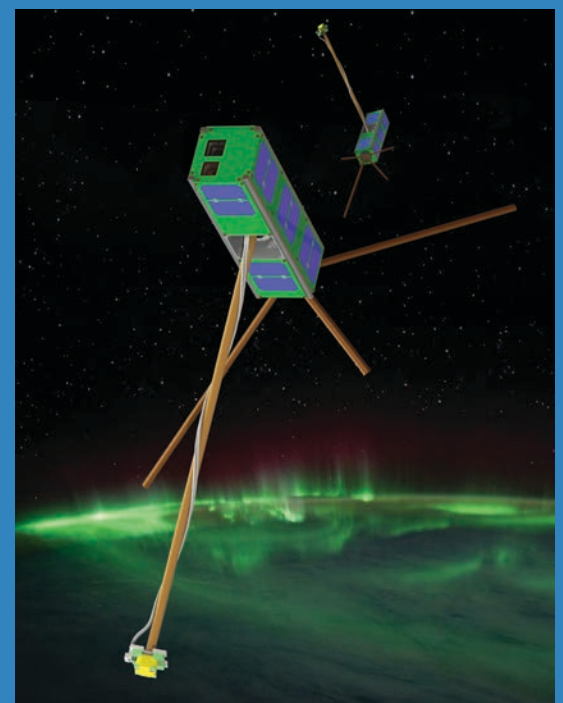


Dr. Mackenzie Day, a sedimentary geologist and planetary scientist, will join EPSS as an assistant professor in July 2018. Dr. Day received her B.S. in geology from Caltech and completed her Ph.D. at the University of Texas at Austin. Dr. Day will join EPSS after a one-year postdoc at the University of Washington, where she is currently studying sandstone deposits on Mars. A native of the Seattle area, Dr. Day was originally drawn to geology because of her love of the outdoors. Combining her love of fieldwork and fascination for other planets, Dr. Day's research focuses primarily on aeolian systems on Earth and Mars. Dr. Day aims to ground her planetary interpretations in a solid understanding of terrestrial geology, and therefore pairs her Mars research with related field studies on Earth. Dr. Day's background also extends to experimental sedimentology, and to facilitate such research Dr. Day plans to build a wind tunnel at UCLA. The tunnel will take advantage of the

unique geometry in the lab space to support the experiments related to both surface transport and the accumulation of aeolian stratigraphy. Dr. Day's group will use a combination of experimental, field, and remote sensing methods to answer questions fundamental to our understanding of the motion of sand. Although her focus is now on Earth and Mars, Dr. Day plans to expand her work to include other planetary bodies and eventually understand sand transport in arbitrary fluid gravity conditions. Dr. Day is excited to return to sunny Southern California and looks forward to joining the EPSS and UCLA community.

ELFIN-STAR by Emmanuel Masongsong and Vassilis Angelopoulos

In 2013, Professor Vassilis Angelopoulos was funded by the U.S. Air Force and NASA/NSF to build UCLA's first satellite named ELFIN, a tiny "CubeSat" about the size of a two-liter soda bottle. The spacecraft's structural elements, electronics, and sensors were developed and built by a team of dedicated EPSS staff, graduate students, and over 40 UCLA undergraduates from many disciplines. ELFIN will study space weather: how solar wind particles and radiation behave in the Earth's magnetosphere, a region where magnetic storms can damage space infrastructure like GPS, communication, and weather satellites, and even disable the global electrical grid. We are thrilled to announce that NASA has approved additional funding to build and launch a second identical ELFIN satellite. Both satellites will carpool to space on a Delta II rocket in early September 2018. ELFIN* (or ELFIN-STAR) stands for Electron Losses and Fields INvestigation with Spatio-Temporal Ambiguity Resolution. Both spacecraft will be on a similar orbit and will measure how electrons in the magnetosphere are changing in time and space. Having two satellites will help resolve the temporal and spatial variations. ELFIN* will help us understand how quickly the radiation belts are depleted of relativistic electrons and will allow us to build better space weather prediction models.



The View from Above: Drones Take UCLA Earth Science Sky High

by Emmons McKinney



Professor Seulgi Moon and her graduate student, Jessica Lin, prepare to launch a drone over a suite of Quaternary alluvial terraces on Isla Angel de la Guarda, an uninhabited island off the eastern coast of Baja California, Mexico. Photo credit: Nathan Brown.

Unmanned aerial vehicles (UAVs), a.k.a. drones, provide a powerful and efficient platform to study Earth processes at an intimate level. The accessibility and affordability of DIY high-resolution data collection has pushed drones to the forefront of geoscience research. EPSS is on board with its growing fleet of specialized remote-controlled aircraft.

Geology Professor Seulgi Moon uses a photogrammetric technique known as “structure from motion” to study geomorphology and landscape evolution. Her DJI Phantom 3 Pro can regularly be heard buzzing around an active landslide in Santa Clarita and over the expressive topography of the San Andreas Fault. The Vasquez Road landslide has been regularly monitored for more than a year to quantify slippage since the collapse in 2015. EPSS students Emmons McKinney and Allison Hui assisted in piloting the drone and collecting images. The images were georeferenced to create a time series of landscape models, then cross-compared on a point-by-point basis to precisely characterize the landslide’s evolution in 3D. Acquiring this level of detail would not be feasible or affordable using full-size helicopters or airplanes. In 2016, Emil Chang (UCLA ’16) analyzed the San Andreas Fault scarp for degradation at the Dragon’s Back compressional ridge in the Carrizo Plain National Monument. Using drone data, he was able to extract 50 topographic profiles along the fault to test geomorphological dating methods.

The Geophysics Drone Enhanced Survey Instrument (GEODESI) measures the Earth’s magnetic field near the ground. Magnetic sensors detect distortions in this field, which can reveal subsurface earthquake fault structure, oil and mineral deposits, and even large meteorites. Initiated by Geophysics and Space Physics Professor Vassilis Angelopoulos, GEODESI significantly enhances the quality and quantity of data taken by his students in the field, zooming easily above precarious fault terrain. Powered by eight electric motors with a 4-foot wingspan, the 22-pound beast was built and flown by EPSS’s very own FAA-licensed drone wizard, Emmanuel Masongsong. GEODESI made its successful maiden flight in August 2017 thanks to the efforts of students Axel Wong, Jeffrey Wang, and Jewel Abbate, with creative Arduino coding by summer intern Hector Medina. Their first assignment will be to map the magnetism of the Dragon’s Back ridge to corroborate Emil Chang’s data, followed by a geophysics field course in the spring.

Drone technology is revolutionizing Earth science education, giving students the power to visualize and manipulate data like never before. By designing and flying their own missions, and then analyzing and presenting their results, EPSS students become well prepared for cutting-edge careers in geoscience research and industry.

Exploring Your Universe 2017

On November 5, 2017, EPSS once again co-hosted the annual Exploring Your Universe science festival, which is family friendly and always open to the public, and regularly welcomes thousands of people to campus for hands-on experiments, tours of the Meteorite Gallery, and exciting lectures. EPSS is proud to have co-sponsored this popular outreach event every year since its inception in 2009. Among the participating departments, EPSS had the largest number of exhibits—15 altogether—including seismology, magnetism, and fluid dynamics demonstrations. Other booths described some of the NASA missions that UCLA leads or participates in, including the ELFIN mission (page 6), the Parker Solar Probe, THEMIS and ARTEMIS, Cassini, and the Lunar Reconnaissance Orbiter. Rocks, minerals, and fossils were also on display. EPSS students, researchers, and faculty enthusiastically answered the call for volunteers and communicated their passion about science to inquisitive minds.

EPSS is proud to have co-sponsored the Exploring Your Universe science festival every year since its inception in 2009. Thousands of participants were infected by the enthusiasm of Earth, Planetary, and Space Sciences volunteers.





Exploring Your Universe 2017 photos:
(Top left) EPSS graduate student Krista Sawchuck exhibits fluorescent minerals with an ultraviolet light and a box that she decorated. (Bottom left) EPSS Professor Tina Treude and her research group exhibit marine core samples. (Top right) EPSS graduate student Ashley Schoenfeld uses a scale model of the Cassini spacecraft to describe instruments and science investigations. (Bottom right) Budding solar scientists observe sunspots with a solar telescope and solar glasses. Photo credits: Mojghan Haghnegahdar and Damon Cirulli (bottom right).

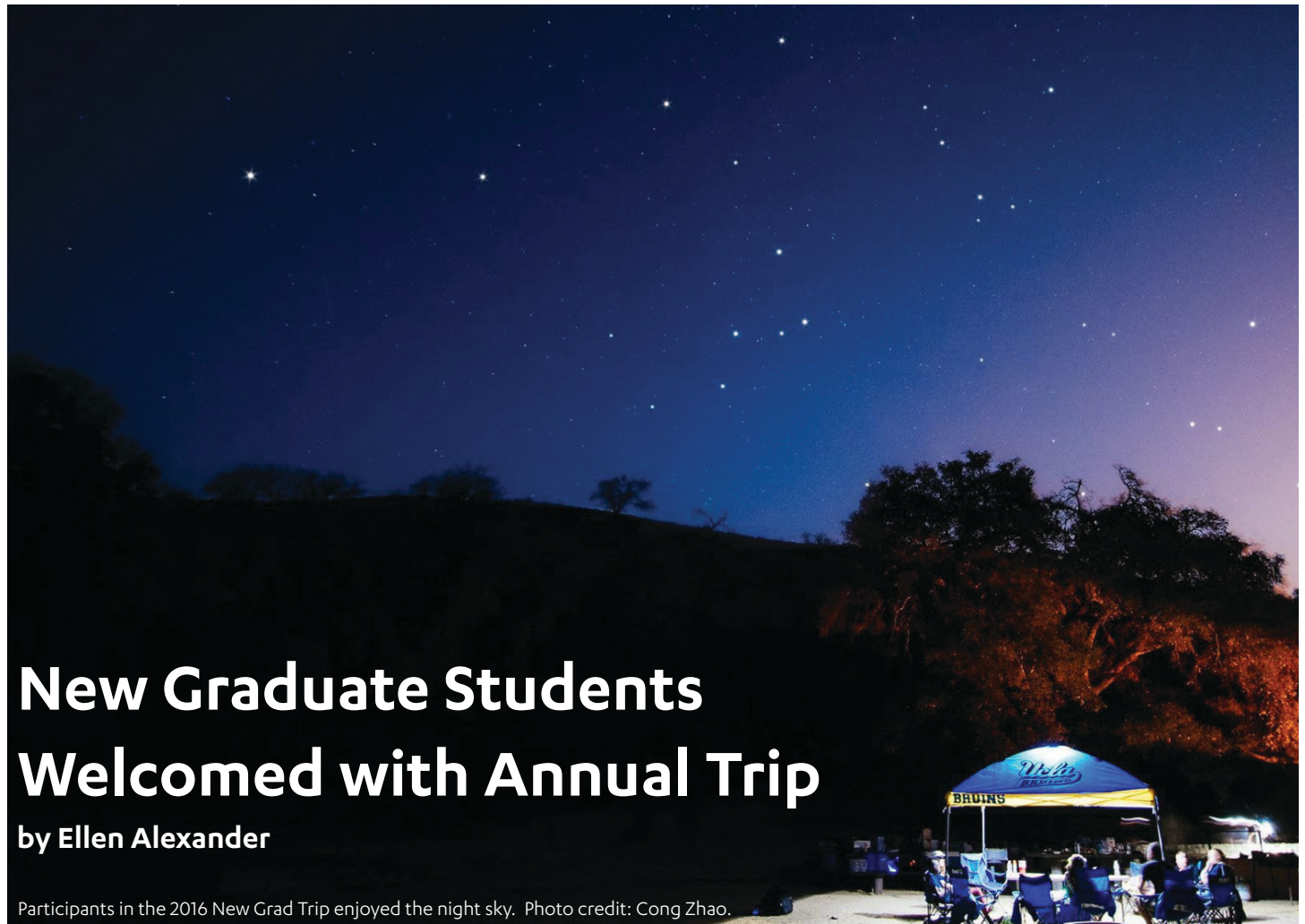
Summer Field Program by Christian Pelayo

This year, Professor An Yin once again taught the Summer Field Program (EPSS 121F), which took place from June 22 to July 21. There were 17 UCLA students, two visiting scholars, two teaching assistants, and one instructor. Our class gathered at the EPSS loading dock on an early Thursday morning and prepared for the long drive to Bishop, California in the Department's field vehicles. Every Monday, Tuesday, Thursday, and Friday our class departed from camp at 6 a.m. sharp to map the notorious Poleta Folds area. Its rich, complex Cenozoic history can be inferred only by the displacement and deformation of Paleozoic carbonates. We mapped in pairs but occasionally ran into other students in this 3x2 km area. A short "Hello, where are you from?" revealed that we were sharing this space with students from UC Riverside and UC Santa Cruz. After a few walkthroughs on lithology and structures, Professor Yin set us loose on our own to learn the secrets of Poleta Folds. Every day at 3 p.m. we returned to town to refill our water jugs and restock on food at Carroll's Market in Big Pine, California. A large, ice-cold 79¢ soda felt heavenly after a day of soaking in the sun. On Wednesdays our class went on field trips to learn more about the regional geology and its influence on our study area. It was inspiring to listen to Arthur Sylvester's lectures on Papoose Flats, a significant area in his study of pluton emplacement. The scorching heat of Death Valley forged our knowledge as much as it wore down our tires. The trip to Long Lake in the Sierra Nevada, a student favorite, included a breathtaking view of a crystal-clear lake surrounded by snow-covered mountains even in the midst of summer. On Saturdays we mapped for half a day and enjoyed the rest of the time off in Bishop. Many students enjoyed the Looney Bean's special—the Green Monkey, a green tea banana Frappuccino—while writing their reports. One could also enjoy the legendary and savory beef brisket at Copper Top BBQ. Trying to figure out the history of Poleta Folds was frustrating, but towards the end of the Summer Field Program, many of us wanted to stay, not only for our field reports but for our own understanding. I left Poleta Folds with a dim light over a once darkened, unknown area.



2017 Summer Field Program participants at Long Lake in the Sierra Nevada.

Professor An Yin's goals for Summer Field students include developing critical thinking skills, integrating sound field observations with hypothesis testing, enhancing teamwork, and improving oral and written communication skills.



New Graduate Students Welcomed with Annual Trip

by Ellen Alexander

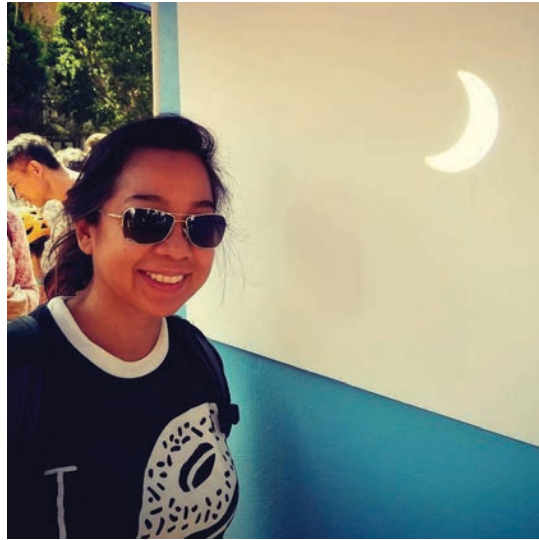
Participants in the 2016 New Grad Trip enjoyed the night sky. Photo credit: Cong Zhao.

Every year the Earth, Planetary, and Space Sciences Student Organization (EPSSSO) welcomes incoming graduate students with a free camping trip to a fun outdoor area in Southern California just before New Student Orientation. In Fall 2016, new and current students visited the Santa Barbara coastline, where we camped on the Santa Ynez River in the Los Padres National Forest. We hiked in the mountains, kayaked on the Pacific Ocean, played Bubble Soccer, relaxed on the beach, visited local attractions, and enjoyed the starry nights together. In Fall 2017, we are headed to Big Bear Lake in the San Bernardino Mountains, located east of Los Angeles. The New Grad Trip offers a fun environment for incoming and current graduate students to get to know each other, enjoy the beautiful outdoors, and start grad school with a weekend of fun. It is a unique opportunity for new students, many of whom are new to Southern California, to make new friends and integrate into the EPSS graduate student community. We also get the opportunity to see the geology of Southern California, visiting a different location every year. Space physicists and field geologists alike enjoy this yearly outdoor adventure; friendships that begin on the New Grad Trip last through grad school and beyond. The trip is organized by EPSSSO with partial financial support from the Department's alumni fund.

The Great American Eclipse at UCLA

by Emmanuel Masongsong

On Monday, August 21, 2017, UCLA held a viewing party for the Great American Eclipse, drawing an excited crowd of nearly 3,000 people to the Court of Sciences on south campus. The event was organized by EPSS, with support from two student groups: Astronomy Live! and Optical Society of America. Visitors began lining up at 7 a.m. for a pair of free eclipse glasses and a chance to see the Sun up close through specially filtered telescopes. The line grew quickly as more people kept arriving, though a layer of low clouds still obscured the Sun. Thankfully, by 9 a.m. the clouds had mostly dissipated and there was a collective gasp as the first hint of the Moon became visible. Hundreds of people crowded around the eclipse selfie photo booth where an image of the Sun was projected onto a white screen, posting images on social media with the hashtag #UCLAeclipse. Throughout the event volunteers were on hand to represent various NASA missions with EPSS involvement and cutting-edge solar, lunar, and space weather research, including students building UCLA's first satellite, ELFIN (scheduled for launch in Fall 2018). By 10:21 a.m., the time of maximal eclipse, the mood was jubilant and inspired with normal sunlight noticeably dimmed and a cool breeze. Students, staff, faculty, children, and even dogs filled the plaza beyond capacity, with strangers happily sharing viewing glasses and snapping photos of the celestial spectacle. Although not a total eclipse, this was an unforgettable experience for the Bruin community, celebrating the dance of our star and moon!



The selfie screen with a projected image of the eclipsed Sun was quite popular.



Free eclipse glasses provided a safe viewing experience for all ages.





EPSS provided eclipse glasses for patients at UCLA Mattel Children's Hospital.



EPSS's four Sunspotters were particularly effective at displaying the progression of the eclipse. They were purchased with a generous gift from Michael Thacher and Rhonda Rundle.

“You see the crescent moon all the time, but you never really see a crescent sun. I know it’s just an optical illusion, but at the same time it’s a pretty cool thing to see.” EPSS graduate student and event volunteer Fekireselassie Beyene



Photo credit: Brian Haas

Total Solar Eclipse in Oregon and Idaho

Many eclipse enthusiasts traveled to the narrow path of totality to witness the total solar eclipse on August 21, 2017. Among them were 32 alumni and friends of EPSS who traveled to Powell Butte, Oregon on a four-day trip to witness totality with EPSS Professors Jean-Luc Margot and Seulgi Moon, EPSS graduate student Heather Kirkpatrick, and EPSS staff member Hilda Avanesian. Professor Moon and Heather described the geology of Oregon during breathtaking excursions to the Newberry Caldera and Smith Rock State Park. EPSS Professor Kevin McKeegan served as the faculty host on a four-day UCLA Alumni Travel trip to Swan Valley, Idaho. About 40 alumni and friends joined Professor McKeegan on a tour of Yellowstone National Park prior to viewing the total solar eclipse. Craig Seidel, a participant of the Idaho trip, snapped a beautiful photo of the eclipsed Sun (cover photo). The experience of totality turned out to be more emotional and memorable than many had anticipated.

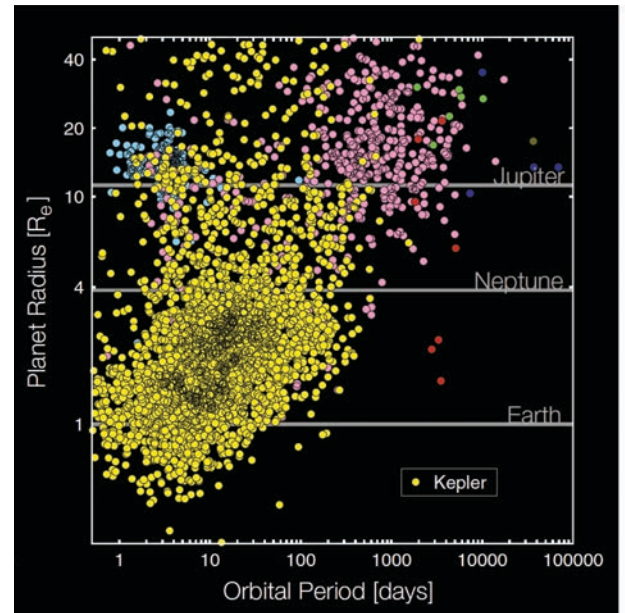


(Top left) EPSS Professor Kevin McKeegan (left) with Arlene and Ted Schlazer at Yellowstone National Park. (Top right) EPSS Professor Emerita Margaret Kivelson admires the eclipse in Oregon. (Photo credit: Pam Kivelson). (Middle) EPSS alumni and friends on a private ranch in Madras, Oregon. (Bottom) UCLA Alumni Travel trip participants in Swan Valley, Idaho.



Planets Around Other Stars

On April 5, 2017, EPSS hosted a public talk given by William Borucki, the principal investigator of NASA's Kepler mission. The talk was titled "Planets Around Other Stars" and drew more than 200 people to Korn Convocation Hall on the UCLA campus. During the introduction, Bill Borucki was compared to Galileo because he has "truly transformed our view of the universe." Attendees learned about the Kepler space telescope and its ability to monitor more than 145,000 stars continuously to detect changes in starlight, the discovery of thousands of exoplanets, the fraction of Earth-size planets in the Milky Way Galaxy, and the possibility of extraterrestrial life on other planets. Borucki dwelled on Kepler-22b, which may be hospitable to certain life forms due to its ample water and suitable temperature. Following the lecture, Borucki answered questions from the audience. The event was made possible by a generous gift from Michael Thacher and Rhonda Rundle.



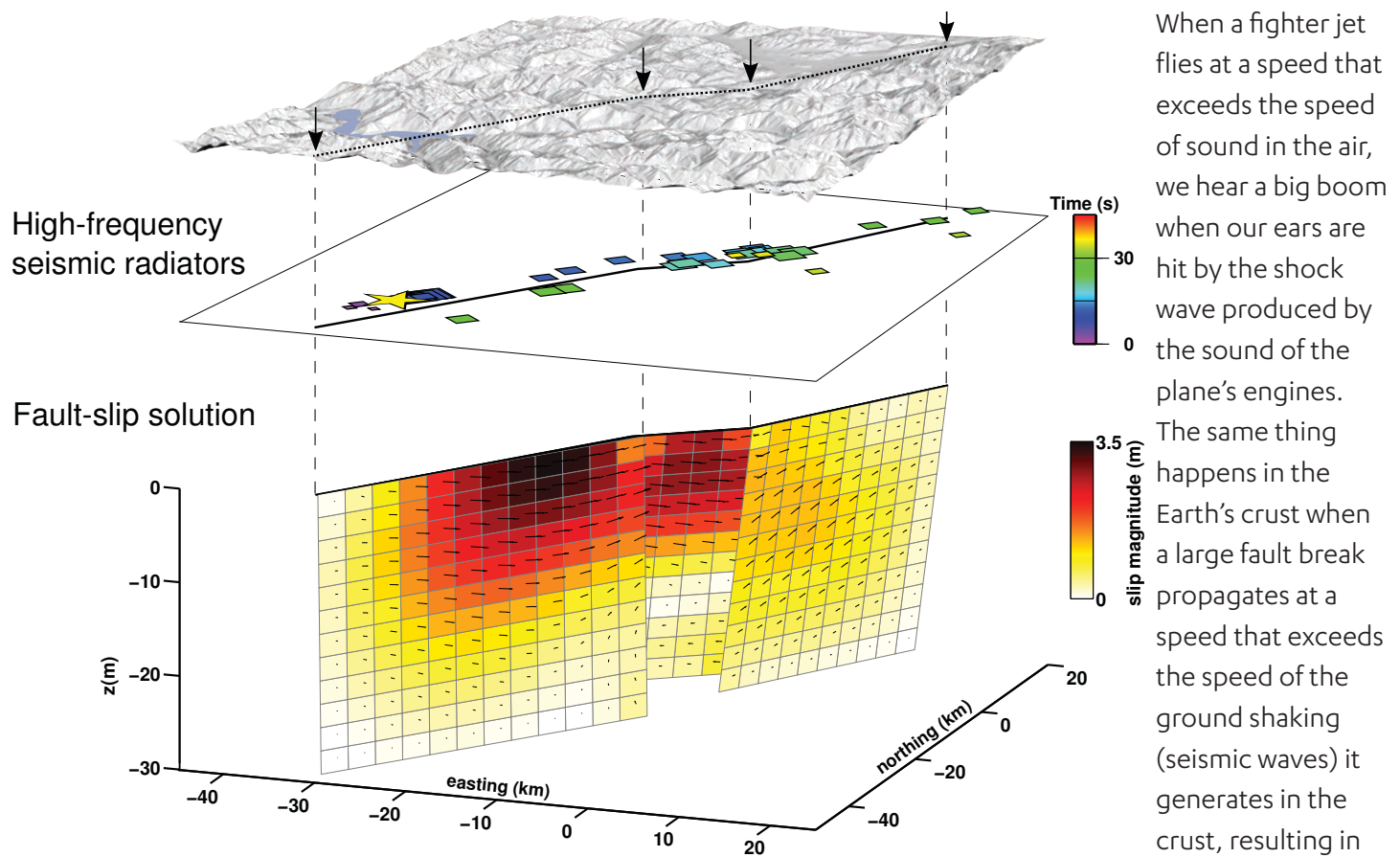
(Top left) A star-struck space enthusiast asks questions after Bill Borucki's talk. (Top right) Kepler discoveries (yellow dots) shown in a period-radius diagram (from Batalha 2014). Results from the Kepler mission indicate that most stars have at least one planet, that 85% of planets in the Kepler sample are smaller than Neptune, and that tens of billions of approximately Earth-size planets orbit in the habitable zone of their respective host stars, where liquid water may exist. (Bottom right) Donors Michael Thacher and Rhonda Rundle converse with Bill Borucki (left) while a *Daily Bruin* reporter takes notes.



"I think intelligent life on other planets might exist. It's a nonzero probability." Borucki lecture attendee Srinivas Prasad

Supersonic Break in Tajikistan Earthquake

by Simran Sangha and Gilles Peltzer



When a fighter jet flies at a speed that exceeds the speed of sound in the air, we hear a big boom when our ears are hit by the shock wave produced by the sound of the plane's engines. The same thing happens in the Earth's crust when a large fault break propagates at a speed that exceeds the speed of the ground shaking (seismic waves) it generates in the crust, resulting in intense shaking when the waves pass by. This

Earthquake fault geometry and fault-slip solution. (Top) Shaded topography and surface break. (Middle) Location of high-frequency seismic radiators colored by time during rupture propagation. (Bottom) Static slip solution from radar data inversion.

behavior is called “super-shear propagation” and has been observed in large earthquakes by analyzing the seismic waves that are radiated from the tip of a rupture as the earthquake develops. When a $M7.2$ earthquake hit a remote valley of Tajikistan in December 2015, EPSS graduate students Simran Sangha and Ailin Zhang and their UCLA and JPL colleagues combined efforts to understand the mechanism of its rupture. Using radar and optical images acquired from satellites, they showed that the fault break was formed of two straight segments with a kink in the middle and large displacement patches concentrated on both sides of the kink. The seismic waves analysis further revealed that super-shear propagation occurred on the two straight segments and that the rupture slowed down when passing through the kink. Super-shear propagation has been generally observed on earthquakes of larger magnitude ($M8$). The findings of the present study show that earthquakes of more moderate magnitude can actually break at super-shear velocity and that the geometry of the break appears to control the propagation through time. Because super-shear earthquakes are potentially more destructive than regular earthquakes, mapping the geometry of faults and estimating the maximum size of earthquakes they can produce is an important part of the seismic hazard assessment for a region. In the case of the Tajikistan event, a particular concern was the stability of the nearby Usoi Dam, formed by a landslide during a large earthquake in 1911. The dam lies upstream of communities where millions of people reside. Fortunately, the analysis of optical imagery acquired before and after the 2015 event did not show any settlement of the dam embankment. Ongoing work is done to continue monitoring the dam's stability. The work was published in *Earth and Planetary Science Letters* in January 2017.

Donald Carlisle (1919-2017)

It is with great sorrow that we inform you that our colleague and dear friend, Professor Emeritus Donald Carlisle, passed away on January 10, 2017. His wife, Gloria Galvez-Carlisle, said that he died peacefully in his sleep. He was 97. Don was Professor of Geology in EPSS and its predecessor departments from 1949 until his retirement in 1989. He and Gloria founded the Donald Carlisle Undergraduate Research Endowed Fund to support original research in EPSS. His warm smile and bright sense of humor will be missed. An on-campus memorial service on February 8, 2017 was attended by many of Don's friends and former students.



Donald Carlisle

Undergraduate Research Awards



Recipients of EPSS undergraduate research awards (left to right): Emmons McKinney, Alexandria Arnold, Mary Braza, Ernest Gomis.

Thanks to the generosity of alumni and friends of the Department, we have been able to incentivize undergraduate research in EPSS. A call for proposals was sent to undergraduate students and faculty, and a small number of proposals were selected on the basis of merit. Each award funds up to 20 or 40 hours a week of a student's research time during the academic year and summer, respectively. Some awards are supplemented by travel funds to present the results at a scientific conference. The experience was so successful and positive that we will be repeating it on an annual basis. We are pleased to showcase the recipients of the 2017 undergraduate research awards.

Two students benefited from the Straus Family Fund for Undergraduate Opportunity. Emmons McKinney worked with Professor Seulgi Moon to perform a drone-based photogrammetric survey and construct 3D elevation models to quantify the movement of an active landslide (page 7). Ernest Gomis worked with Professor Jon Aurnou to design and build a magnetohydrodynamics outreach demonstration that illustrates how electromagnetic forces can drive fluid motion. Thanks to the J. Douglas and Patricia Traxler Scholarship Fund, Mary Braza worked with Professor Ray Ingersoll to study the tectonic evolution of Southern California, specifically transrotation, by collecting and analyzing samples from the Topanga Formation. The Donald Carlisle Undergraduate Research Endowed Fund made it possible for Alexandria Arnold to work with Professor Aradhna Tripathi to analyze microfossils in sediment cores with the goal of understanding changes in the carbon cycle and climate in the North Pacific over the past five million years. Award recipient Ernest Gomis remarked: "The research award was very useful to me. [The project] furthered my understanding of electricity, magnetism, and their combined effect on charged particles. ... I have learned that research takes time, and persistence and curiosity are very important. ... Thank you to the Straus Family for this unforgettable opportunity!"

Commencement 2017



Nathan Brown was awarded the W. Gary Ernst Fellowship in the presence of Commencement Speaker W. Gary Ernst, EPSS Graduate Advisor Vassilis Angelopoulos (left), and EPSS Chair Jean-Luc Margot (right).

“UCLA gave me a richly diversified platform for my own intellectual development—and the opportunity to take some scientific chances.”
W. Gary Ernst,
Commencement
2017 Speaker



Photo credit: Michelle Pang.

Degrees

Bachelor of Arts

Alexandrea Jay Arnold
Nathaniel Raul Davila
Nicole Elizabeth DeVries
Lauren Elizabeth Didio
Nancy Zavala Herrera
Kristina Noelle Nicholas

Bachelor of Science

Mary Elizabeth Rouse Braza
Andrew Seth Buckley
Casey James Crampton
Danielle Giesy
Maegan Athena Ballon Gonzales
Samantha Hangsan
Yooliana Heo
Eduardo Hernandez
Allison Wai-Ting Hui
Jessica Ying Huynh
Nicholas Joseph Inserra
Gregory Stuart Jesmok
Sarah Ayed Kanee
Anne Marie Kelley
Julien Y-Son Kuhn de Chizelle
Jason Mathiyakom
Emmons McKinney
Alexandra Grace Michell
David Ashraf Moussa
Donald Nguyen
Juliet Rose Olsen
Michael Christopher Say
Janelle Johanna Spandau-Buts
Jennifer Um
Deepshikha Upadhyay
Omar Valdivia-Romo
Shiqi "Axel" Wang

Master of Science

Kynan Horace George Hughson
Napoleon Pempena
Chen Shi
Erik Christopher Weidner
Haotian Xu
Wentao Xu
Xu Zhang

Doctor of Philosophy

Jeanine Louise Ash
Patrick Boehnke
Nathan David Brown
Alexander Michael Grannan
Junko Isa
Michelle Kay Jordan
Michael Joseph Lawson
Christopher Jorge Snead
Matthew Edward Walker



Photo credit: Michelle Pang.



Photo credit: Michelle Pang.

Co-Valedictorians Mary Braza (left) and Janelle Spandau-Buts (right).



Eduardo Hernandez (left) and Shiqi "Axel" Wang (right) celebrate at the Inverted Fountain.

Students and Student Awards

EPSS welcomed 13 new graduate students in Fall 2017 from a pool of over 100 applicants. Over the past year, EPSS awarded seven M.S. degrees and nine Ph.D. degrees (page 19). Our students continue to do very well in their professional endeavors. We maintain a list of professional outcomes at <http://epss.ucla.edu/people/alumni/> and welcome any updates you may have. If you are looking for talent, please consider EPSS graduates. We are proud of the training they receive and of their overall performance and preparedness for the workplace. Undergraduate and graduate student awards are listed below, and undergraduate research awards are highlighted on page 17.

Undergraduate Awards

John & Frances Handin Scholarship

Presented to undergraduates for scholastic excellence, endowed by alumnus John W. Handin & his wife, Frances

Michael Christopher Say Janelle Johanna Spandau-Buts

Eugene B. Waggoner Scholarship

Presented to undergraduates for scholastic excellence, in honor of alumnus Eugene B. Waggoner

Deepshikha Upadhyay

Clem Nelson Summer Field Award

Presented to summer field students, in honor of Professor Clem Nelson

Randon James Flores Isaac Chongmyong Park
Drew Elliot Sachs Gomberg Christian Niguel Pelayo

Clarence A. Hall, Jr. Summer Field Award

Presented to summer field students, in honor of Professor Emeritus Clarence A. Hall, Jr.

Michael Gerardo Arreola-Zamora Jason Mathiyakom
Corey James Bair Tristan Jon Whisenant
Ernest Alexandre Gomis

Deane Oberste-Lehn Field Award

Presented to summer field students, in honor of alumna Deane Oberste-Lehn

Marina Olivia Argueta Coralie Dean Rodriguez
Yooliana Heo Janelle Johanna Spandau-Buts
Jessica Ying Huynh Casey Amanda Yamamoto-Hillman
Van Van Huynh

Walter S. Harris Summer Field Award

Presented to summer field students in memory of Walter S. Harris

Ryan Michael Missel

Straus Family Undergraduate Research Award

Ernest Alexandre Gomis Emmons McKinney

Donald Carlisle Undergraduate Research Award

Alexandrea Jay Arnold

Traxler Undergraduate Research Award

Mary Elizabeth Rouse Braza

Graduate Awards

W. Gary Ernst Fellowship

Provides a quarter of support to a graduate student, endowed by alumnus W. Gary Ernst

Nathan David Brown

Eugene B. Waggoner Scholarship

Presented to a graduate student on the basis of merit, endowed by alumnus Eugene B. Waggoner

Amanda Garcia

Harold and Mayla Sullwold Scholarship

Presented to graduate students on the basis of merit, endowed by Harold and Mayla Sullwold

Janine Ash
Zixu Liu
Simran Sangha
Michaela Villarreal

Outstanding Teaching Assistant

Presented to graduate students to recognize outstanding performance in teaching

Ellen Alexander
Amanda Garcia
Erin Leonard
Simran Sangha
Alexandra Schneider
Ashley Schoenfeld
Abijah Simon
Erik Weidner

Extramural Funding Award

Presented to graduate students who secured multi-year funding from an extramural agency

Lydia Bingley
Erin Leonard
Dave Milewski

Postcards from the Field

When did plate tectonics begin on Earth? That is the question that a multinational research group including EPSS alumnus Alex Webb (Ph.D. 2007) and EPSS graduate student Peter Haproff sought to address during the summer of 2017. They mapped Archean rocks in southwest Greenland for five weeks and shared their photos with us.



Photo credit: Peter Haproff

Comings and Goings

The Department welcomed six new staff members this year.

- Hilda Avanesian facilitates EPSS events and operations, and assists the EPSS Chair.
- Eric Wessenauer manages our building and interacts with UCLA Facilities for renovations and repairs.
- Henry Gonzalez assists with building issues, field vehicle and equipment maintenance, and instructional demos.
- Frankie Masi assists with purchasing.
- Monica Alfredsen coordinates academic personnel appointments, merits, and promotions.
- Roderick O'Connor supports information technology needs, including the EPSS website.

There were also several staff departures over the past year.

- Alma Zavala took a position better aligned with her fund management aspirations.
- Brenda Duran-Weeks is moving with her family to Vancouver, Canada.
- Herumi Baylon took a position at UC Irvine, closer to her family in San Diego.
- Jason Pang advanced to a higher position in another unit on campus.

On June 19, 2017, EPSS hosted a memorable party to honor the career of Professor Ray Ingersoll and wish him well in his retirement. Professor Ingersoll continues to mentor students and seems happier than ever now that he has more time to engage in research.

Gifts and Giving

We are extremely grateful for the gifts that enable our mission. Donors who made gifts to the Department of Earth, Planetary, and Space Sciences between July 1, 2016 and June 30, 2017 are listed on the opposite page. Gifts made after June 30 will be acknowledged in the 2018 newsletter.

We would especially like to thank those donors who have contributed endowed gifts to the Department (listed below). Endowed gifts are particularly helpful because they enable initiatives in perpetuity. As we experience reduced state support and grant support, endowments will ensure that we can continue to improve the quality of EPSS research and teaching, and elevate the Department's reputation.

For a limited time, EPSS has a rare opportunity to secure a 1-to-1 match for any endowment between \$100,000 and \$1,000,000 and a 2-to-1 match for any graduate student endowment between \$250,000 and \$1,000,000. Please contact the EPSS Chair (chair@epss.ucla.edu) or Brooke Sanders (bsanders@support.ucla.edu) for details.

Donald Carlisle and Gloria Gálvez-Carlisle

Donald Carlisle Undergraduate Research Endowed Fund

W. Gary and Charlotte Ernst

W. Gary Ernst Endowed Graduate Fellowship

John and Frances Handin

John and Frances Handin Endowed Scholarship

Charlotte H. Johnston

Walter S. Harris Summer Field Endowed Fund

Joanne Knopoff

Leon and Joanne V.C. Knopoff Term Chair in Physics and Geophysics

Deane Oberste-Lehn

Deane Oberste-Lehn Endowed Scholarship

Robert and Jeannette Paschall

Robert and Jeannette Paschall Endowed Fund

John L. Rosenfeld

John L. and Juanita B. Rosenfeld Endowed Graduate Fellowship

J. William and Jane Shen Schopf

J. William and Jane Shen Schopf Endowed Faculty and Staff Enrichment Fund

J. William and Jane Shen Schopf Endowed EPSS Spousal/ Partner Employment Opportunity Fund

Wilbur B. Sherman

Wilbur B. Sherman Endowed Fellowship

Joe and Andrea Straus

Joe and Andrea Straus Endowment for Undergraduate Opportunity

Harold and Mayla Sullwold

Harold and Mayla Sullwold Endowed Scholarship

J. Douglas and Patricia Traxler

J. Douglas and Patricia Traxler Scholarship

Eugene B. and Winifred Waggoner

Eugene B. Waggoner Endowed Scholarship

Mary Lou and Ward Whaling

Louis B. and Martha B. Slichter Endowed Chair in Geosciences

Donor Recognition

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Vassilis Angelopoulos and
Mary Christianakis
David and Tiffany Ayres
Shirley Baher
Jessica Ban
Gary and Nancy Beverage
Bruce Bilodeau and Deborah Wechsler
Michael Binder and Sheila Etzkorn
Charles and Rose Blount
Wendy Bohrson
Matthew Bourke
Arnie Boyarsky
Mary Braza
Robert Brockway and Dana Ware
Timothy and Carlene Brown
Dwight and Gabriele Carey
Corinna Casey
Elizabeth Catlos
Vallabh Chauhan
Lucy Chen
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Kenneth and Carol Pawlak
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Daniel and Hilary Petrizzo

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Robert and Susan Rich
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