University of California, Berkeley

DEPARTMENT OF **EARTH & PLANETARY SCIENCE**

Alumni Update 2016-2017

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NOTE FROM THE CHAIR

Greetings from Berkeley! It is my pleasure to write you as I serve my third year as Chair of the Earth & Planetary Science Department. Our faculty, staff, students, and alumni continue to make our department one of the best in the nation. I'm pleased to announce that William (Bill) Boos and Daniel Stolper have joined the EPS family as our newest faculty. Bill is an atmospheric scientist, looking closely at tropical monsoons and vortices such as hurricanes. Daniel is a stable-isotope geochemist whose research focuses on how the ratios of isotopes in rocks and gases can be used to measure past temperatures on the Earth. Both will help continue the department's tradition of providing a world-class education to our students on a wide-range of scientific topics that are very important to our understanding of the earth's changing climate.


Richard M. Allen

I want to share with you our fundraising focus for the coming year: EPS undergraduate and graduate students. Living and attending school in the Bay Area is a financial struggle for many of our students, and the fellowships and awards that our alumni provide go a long way to enhancing their educational experience at Berkeley. So please consider giving to the department in a way that helps our amazing students (see the enclosed donation form). And if you are interested in learning more about how to support EPS students and faculty, please feel free to reach out to me. I am eager to meet more of EPS' distinguished alumni. The department is eternally grateful for the donations it receives and we thank you for your generosity. Your support enables our faculty and students to thrive.

Sincerely,
Richard M. Allen, Class of 1954
Professor and Chair, Department of Earth & Planetary Science
rallen@berkeley.edu

DONATION OPPORTUNITIES

Yes! I'd like to support Earth & Planetary Science!

Now more than ever, EPS needs financial support from its alumni and friends in order to support its faculty and students in their research and education. We invite you to give to the **Friends of EPS**, a fund that supports the programs and activities that engage our students and faculty, or **The Earth & Planetary Sciences Scholarship fund** which will provide financial assistance to both undergraduate and graduate students in the Earth & Planetary Science Department. **Donations can also be made online at: http://eps.berkeley.edu/make-gift.** Share your support on social media using the hashtag **#EPSCalBears** and by following us on **FACEBOOK.**

BERKELEY ALUM WINS THIS YEAR'S KARCHER AWARD

The Society of Exploration Geophysicists gave this year's Karcher Award to our recent alumna **Jane Kanitpanyacharoen** for her outstanding research on shale anisotropy. The last time this distinguished award came to Berkeley was 21 years ago when our Earth and Planetary Science colleague James Rector was the recipient.

Jane Kanitpanyacharoen

Mineralogy seems quite far removed from exploration geophysics and yet, with former students like Jane, now a professor in the Geology Department of the University of Bangkok in Thailand, fascinating links became established between microstructures of minerals at the atomic scale and macroscopic properties relevant to hydrocarbon exploration.

They created a lot of interest, leading to a wide range of collaborations. We are very proud that her contributions to rock physics are acknowledged with the prestigious C. Clarence Karcher award.

Jane has had an extraordinary career: In 2003 she received the distinguished Royal Thai Government Scholarship that allowed her to come to the US, first for one year to the Miss Porter's Boarding School in Connecticut, then to Duke University where she became interested in earth sciences and received a B.S. degree with distinction in Earth and Ocean Science. In fall 2008 she came to Berkeley, got immediately involved in research, concentrating on experimental mineral physics. Two first publications with her name on them appeared in 2010 and defined her directions: One was on elastic anisotropy linked to preferred orientation of phyllosilicates in fault gouge, shale and schist. The second one on deformation mechanisms in postperovskite at ultrahigh pressures, connecting diamond anvil cell experiments with seismic anisotropy in the lowermost mantle. In both fields she became engaged during her graduate studies, with 20 journal publications by the time she received her Ph.D. in Earth and Planetary Science from the University of California Berkeley in 2012.

In her four years at Berkeley, Jane worked on a broad range of topics. Her primary focus was the preferred orientation and seismic anisotropy in shales, including classical samples from Kimmeridge, Muderong, Posidonia and Qusaiba, studied with synchrotron diffraction, synchrotron microtomography and scanning electron microscopy, and then linking microstructures to macroscopic physical properties with advanced averaging models that take grain shapes and pore distributions into account. Other projects involved mineral reactions in concrete, microstructures in fault gouge, deformation mechanisms in metals at high pressure, covering a broad range of science, from experiments to theory. This is an amazing record, not only documenting her scientific excellence but also her outstanding impulse to collaborate.

Jane continued with a Geophysics Postdoctoral Fellow at Stanford University before returning in 2014 to Thailand as Lecturer in Geology at Chulalongkorn University in Bangkok. She received in 2015 the "Best Ph.D. Thesis Award" from the National Research Council of Thailand.

At Chulalongkorn, Jane teaches mineralogy and structural geology, educates enthusiastic students who, just like her, continue graduate studies in the United States. She also maintains a research program, collaborating with colleagues in academia and industry. We are convinced she will go a long way in advancing our understanding of rock properties.

STUDENT SPOTLI

BETH CONNERS

Beth Conners

WHY DID YOU COME TO OUR PROGRAM? I am a double major with Biology, and I really love that EPS focuses more on the physics and chemistry of the ocean and the Earth. I decided to pursue marine science at Cal because I wanted to expand my undergraduate experience to explore the physical and chemical components of the ocean. I was drawn to the excellent classes offered, the exciting research, and engaging professors in the department. The department is one of the best Earth sciences departments in the country, after all!

WHAT DREW YOU TO SCIENCE? I was curious and inquisitive as a child, and was absolutely obsessed with dolphins. I wanted to be a dolphin when I grew up when I was younger, actually. When my parents told me that inter-species transformation was not an option, I decided to be the next best thing: a marine biologist.

WHAT ARE YOU STUDYING? I am a double major in Integrative Biology and Marine Science. My degree in Marine Science is within the Earth and Planetary Science department. Some of my favorite classes, like The History of Earth and Marine Geochemistry, have been in the department. As a senior, I am conducting my honors thesis with Professor Jim Bishop on the biological carbon pump.

WHAT DO YOU LIKE ABOUT THE PROGRAM AND/OR UNIVERSITY? I love the flexibility of the Marine Science major, the high level of support provided by EPS, and the wonderful people I've met in the EPS department. I've been able to take unique and exciting classes like Scientific SCUBA diving for my major, and I even studied abroad in French Polynesia, at a Berkeley research station for a semester. While abroad, I got to conduct an independent research project on the impact of plastic and coral, and both my SCUBA class and my time abroad counted towards my degree! But it's the people that make the EPS department exceptional; especially my thesis advisor, Professor Bishop, and the academic advisor for the department, Nadine Spingola-Hutton. The Ramsden scholarship, exclusive to EPS, is another exceptional example of the support provided by the department. The scholarship helps fund undergraduate experiences; for example, I've used the scholarship to fund field trips to the ocean with the department club Ocean Society.

FUTURE PLANS AFTER THE PROGRAM? I am pursuing a Masters program in Marine Biology and Ecology at James Cook University in Townsville, Australia. I plan on studying the Great Barrier Reef, and integrating my knowledge of the biological, physical and chemical processes of the ocean to study climate change and the vulnerable coral reefs.

GHTS

VANESSA ENI

Vanessa Eni

Hello, my name is Vanessa Eni. I am a first-year Ph.D. candidate in Earth and Planetary Science working with Professor. Michael Manga. I completed a Bachelor's in Geology at University of Pennsylvania in 2016 and am very excited to continue my education here at Berkeley with Professor. Manga.

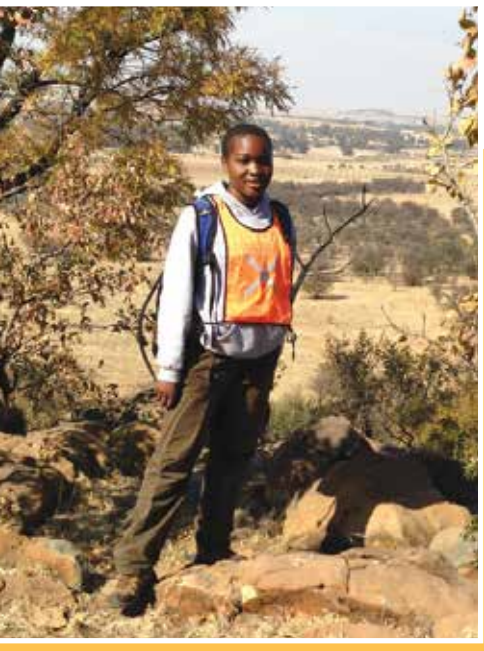
I became interested in geology after growing up in a densely forested suburb aptly called "The Woodlands." During this time I spent a great deal of time outdoors, making observations and collecting rocks. It was during this time I became fascinated with understanding how and why the earth works the way it does. After completing my freshman year at the University of Pennsylvania, I joined the Ph.D. UPenn research team conducting soil biogeochemistry research to determine changes in soil carbon content over time at the French Creek State Park and Delaware watershed in Northeast Pennsylvania. The dynamism of working in the field and the hands-on learning opportunity convinced me to continue my pursuit of science and to enroll in geology courses in my sophomore year.

My interest in the Earth Sciences continuously grew throughout my undergrad years with the exciting opportunity to participate in the World Water Forum 7 conference in Daegu, South Korea and allowing me to conduct intensive geophysics field work in South Africa through University of the Witwatersrand, located in Johannesburg, South Africa.

It was in 2016 that I first visited UC Berkeley to attend the weekend EDGE conference, a visitation program to increase diversity in Ph.D. programs. It was here that I first met Professor. Manga and the other graduate students in his group. My experience at Berkeley was very positive and made choosing Berkeley a very easy choice.

Currently working with Michael Manga, I pursue Earth science research related to fluid dynamics. My first exciting project is centered on quantifying the geothermal system through monitoring a geyser and carbon dating of amorphous quartzite found in the area.

After completing my challenging doctoral program, I plan to find employment, perhaps as a technical consultant, with a planned return to an academia.



Vanessa Eni studying at the Vredefort dome UNESCO World Heritage site in Parys, South Africa.

WELCOME

GET TO KNOW OUR FACULTY

Daniel Stopler

DANIEL STOLPER

I joined the department in January 2017, and am in the process of building a new stable-isotope geochemistry laboratory on the 4th floor of McCone.

My current research focus is the measurement of molecules with two or more rare isotopes. For 70 years, geochemists have used mass spectrometers to measure ratios of stable isotopes (e.g., 13C/12C, 18O/16O, and D/H) in molecules with simple mass spectra (e.g., CO2, H2, and O2). Such measurements revolutionized geochemistry and form the basis of past surface temperature and ice volume reconstructions in paleoclimate research; the identification of microbial metabolic pathways billions of years ago; constraining solar system formation dynamics; and determining ancient hominid diets. The past decade has seen another revolution in measurements and applications of stable isotopes in nature based on the recognition that at low temperatures, heavy isotopes (e.g., 13C and 18O) tend to associate or "clump" together in multiply isotopically substituted (clumped) molecules due to quantum mechanical effects. Because this degree of clumping is a function of temperature, the measurement of clumped-isotope abundances serves as the basis for a geothermometer. This, combined with technical developments that allowed the measurement of the extent of this clumping, has led to new and powerful approaches to reconstructing past environmental temperatures from geological samples for historically intractable problems (e.g., dinosaur body temperatures and the surface temperature of Mars 4 billion years ago.) This is of great interest as temperature is critical to all branches of earth science (e.g.. climate science, earth history, and igneous petrology).

My lab will house two state of the art mass spectrometers (one of which will be one of only seven in the world thanks to the funding from the Heising-Simons Foundation) to measure clumped-isotope abundances in ancient carbonate minerals (e.g., shells) in order to reconstruct past temperatures of the surface of the earth and deep ocean; in methane to understand where and how natural gas forms; and the development of new isotopic measurements in previously unmeasured compounds. Additionally, beyond isotope geochemistry, I am working on problems related to the oxygenation history of the atmosphere and oceans over the past 3.5 billion years.

Figure 1: Precipitation rate in a cloud-resolving simulation of an idealized aquaplanet.

William Boos

WILLIAM BOOS

Every year, thousands of people in Earth's tropics are killed and an average of one million are rendered homeless by floods produced by precipitating atmospheric vortices. Some of these vortices are major hurricanes or super typhoons, with spectacular eyewalls and spiral bands of cumulus towers that are actively studied by thousands of scientists worldwide. But most of the atmospheric vortices responsible for tropical floods have much weaker winds and are even hard to pick out by eye in a satellite image. This was the case this past August: while Hurricane Harvey was deluging the Texan and Louisianan coasts, over 1,200 people were killed and millions displaced by floods in South Asia caused by such weak vortices embedded within the continental-scale monsoon circulation.

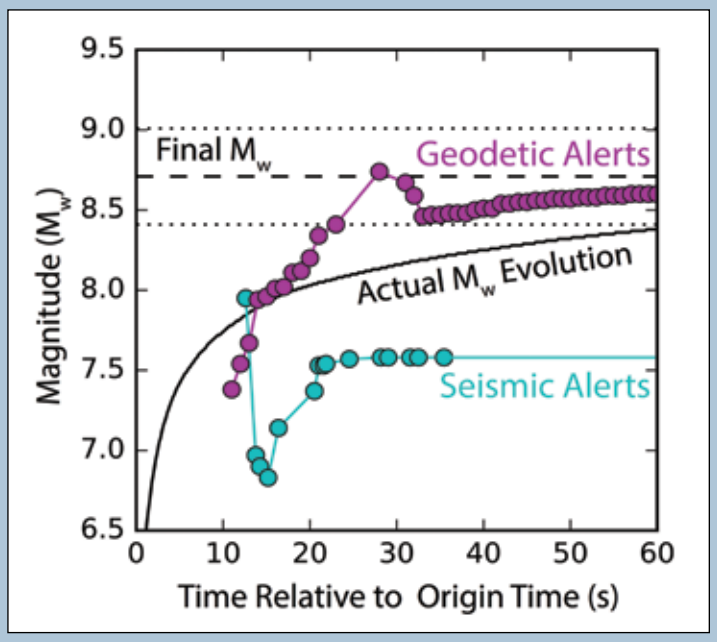
My group is one of the few worldwide that is researching these monsoon vortices, and is perhaps the only one actively advancing understanding of the physical mechanisms responsible for the genesis and amplification of these storms. Just two years ago, we revisited the question of why these vortices travel westward in a region where the mean wind is directed to the east, and we used terabytes of observational data to show that the existing theories of storm propagation dating back to the 1970s were wrong – these vortices travel upstream by nonlinearly advecting vorticity within the larger-scale background monsoon flow. Now, EPS postdoc Michael Diaz is using observations and a custom-built cloud resolving model run on Berkeley's high-performance computing cluster to understand the genesis of these storms, showing how they amplify by extracting kinetic energy from the continental-scale flow in which they are embedded. Our new understanding of the mechanisms of genesis and intensification is expected to facilitate construction of new statistical models used in forecasting.

POSTDOCTORAL SPOTLIGHT

by **Christine J. Ruhl,** Postdoctoral Fellow

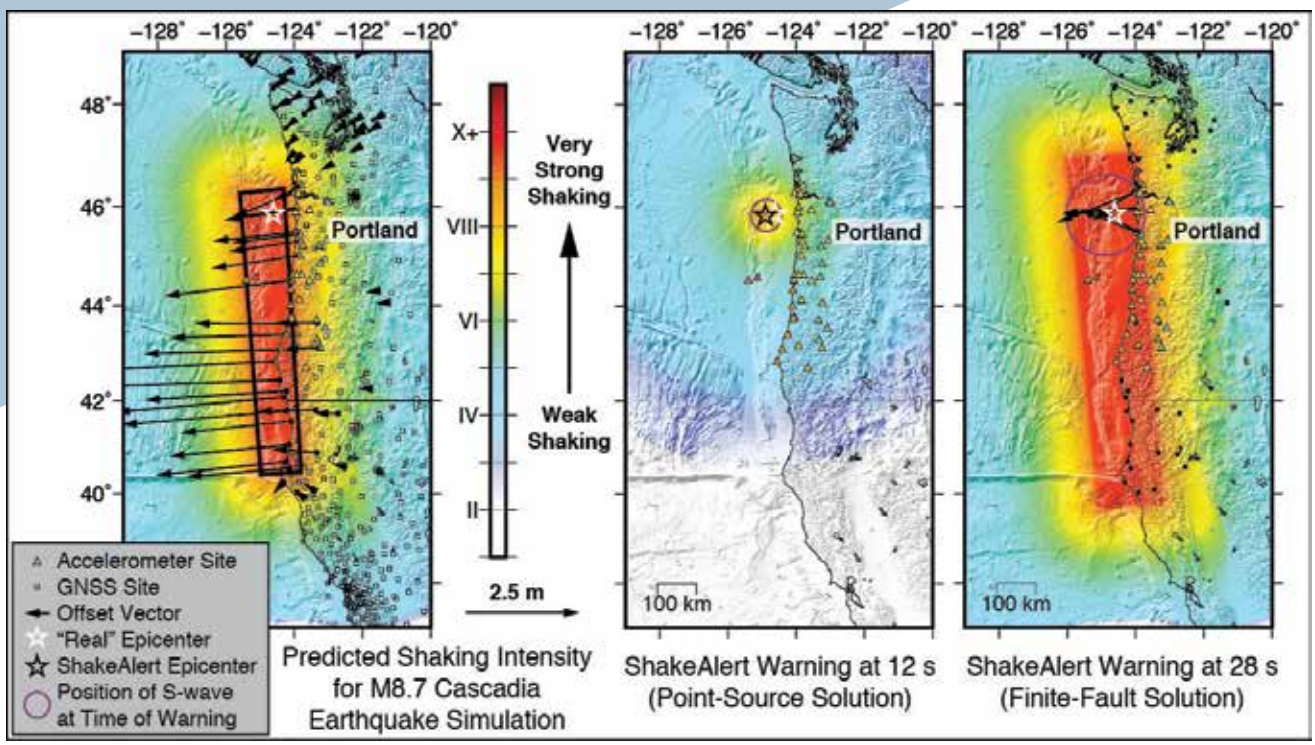
With the public rollout of the ShakeAlert system scheduled for 2018, Earthquake Early Warning (EEW) will soon be a reality along the entire west coast of the contiguous United States. At the UC Berkeley Seismological Laboratory, we maintain real-time networks of both seismic and geodetic instruments to contribute to EEW. Using only the first few seconds of the P-wave recorded by seismic instruments, we are able to detect earthquakes in real time, estimating their magnitudes and epicentral locations (or point-source locations) within seconds of the start of the event. From the point-source information, we can predict ground motions for a particular location and issue alerts before the onset of strong ground shaking. For larger magnitude earthquakes (M>7.0) with longer ruptures, a more accurate picture of ground shaking can be determined from an estimate of the finite fault extent (i.e., finite-fault solutions).

Global Navigation Satellite System (GNSS) sites, as pictured to the left, measure the permanent ground position at any time. When moved suddenly in an earthquake, the change in position (offset) of each site can be measured in real time. GNSS data compliments traditional seismic data and is useful for estimating the finite extent of ruptures and magnitudes for very large earthquakes. The point-source system is tested routinely by small-magnitude earthquakes and we work hard to improve the results by reviewing successes and failures. The finite-fault system, on the other hand, is not exercised regularly due to rarity of large earthquakes.



In order to test the system, we generated synthetic earthquake ruptures on the Cascadia subduction zone. We then replay the broadband accelerograms through the seismic system and the long period displacement waveforms through the geodetic system, completing an end-to-end test in simulated real time. We assess the performance by comparing ground shaking predicted from the earthquake scenario to the ground shaking predicted from both the point-source and finite-fault solutions.

Our results are very promising, showing that with as few as four to six reporting stations, the coupled seismic-geodetic system provides significant warning times and accurate shaking intensity estimates for coastal sites and population centers inland of the Cascadia subduction zone. We are currently testing the ShakeAlert system on international events worldwide and synthetic strike-slip earthquakes in California to better prepare the system for future large earthquakes in the western US.



COMMENCEMENT

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EPS FIELD TRIPS

EPS student **Sarina Patel** exploring Mono Lake.

(To the right) EPS students preparing campsite at Mono Lake.

(Above) EPS Professors **Nicolas Swanson-Hysell** and **Chi-Yuen Wang** instructing EPS: 50 students at Point Reyes.

(Above) EPS students preparing to explore Mono Lake.

(To the left) EPS: 50 studying geomorphology at Point Reyes.

RESEARCH GLIMP

Professor Emeritus **Walter Alvarez** and his little niece Petra, who wants to be a geologist and is known as Petra the Petrologist, doing her first serious field work, in a limestone quarry at Pacifica, on the coast just south of San Francisco. (below left)

At the Geological Society of America meeting at Denver in Fall 2016, there was a double session honoring Walter Alvarez and Eldridge Moores of UC Davis (they were roommates at Princeton in the 1960s). Here is Walter's Renaissance Geology Group at the event (L to R): David Shimabukuro, Luis Erick Aguirre-Palafox, Roland Saekow, Enrico Tavarnelli, Walter, Lung Chan, Kevin Stewart, Mark Anders, Birger Schmitz, and Christian Koeberl. (below right)

PSES

Elizabeth Niespolo on a field excursion in the East African Rift Valley in Afar Ethiopia

Earth & Planetary Science Ph.D. candidates Isabel Fendley, Courtney Sprain and Elizabeth Niespolo conducting fieldwork in the Hell Creek area of Montana. During this extensive fieldwork, the Ph.D. candidates excavated coal beds to study the Cretaceous-Paleogene extinction and recovery interval. Three people shown, Left to Right: Isabel Fendley, Courtney Sprain, Elizabeth Niespolo, all PhD candidates (Courtney actually just graduated) of Paul Renne.

EPS Ph.D. candidates Isable Fendley, Courtney Sprain, and Elizabeth Niespolo conducting fieldwork in the Hell Creek area of Montana.

(Above) Professor Jim Bishop and his students Sylvia Tang, Hannah Bourne, and Todd Wood studying carbon sedimentation in the world's oceans.

Bishop's group developed the CFE to observe rates of carbon sedimentation to kilometer depths for missions lasting up to one year in the ocean. From Right to Left, Undergraduate student Sylvia Targ, Graduate student Hannah Bourne and LBNL Engineer Todd Wood launching a Carbon Flux Explorer in waters 100 km west of Point Conception.
(photo Jim Bishop).