Department of Earth and Planetary Science

Alumni Update • 2013-2014

University of California, Berkeley

Santa Barbara's Day

Photos by: Burkhard Militzer

Tushar Mittal, Ben Fildier, Hannah Bourne, Liz Mitnick, Ben Thurnhoffer, Professor Burkhard Militzer, Thomas Smart, Matthew Diamond. Back Row: William Hawley, Nick Knezek, Michael Antonelli

Jim Watkins (Post-doc), Prof. Michael Manga

Hannah Bourne, Kristen Fauria, Tushar Mittal, Steve Breen

Nick Knezek, Liz Mitnick, Alex Bryk, Matthew Diamond, Ben Thurnhoffer

Marissa Tremblay and Guests

Matthew Diamond, Zack Geballe, Thomas Smart and Guest

Cover photo: Field research in Yellowstone to study geysers.
Photo by: Michael Manga

Editors
Judith Coyote
Layout
Rootid, LLC
Printer
Mercurio Brothers

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State of the Department, 2013-2014

Dear Alumni and Friends,

During my time as Department Chair I have had an opportunity to meet and hear from many of you. It is important for us to know about your professional experiences and to benefit from your insights on changes in the workplace. I am always heartened to hear about faculty members and staff who made a difference in your time at Cal. There is a strong sense of shared ownership among our alumni, and this provides a keen motivation for maintaining our tradition of excellence.

Events over the past year give us plenty of reasons for optimism and pride. Faculty members continue to garner praise and awards for their research and teaching. This past spring Professor Inez Fung was elected to the American Academy of Arts and Sciences. A few weeks later she was elected to the American Philosophical Society, the oldest learned society in the United States, which was founded in 1743 by Benjamin Franklin for the purpose of ``promoting useful knowledge''. In August we learned that three faculty would receive awards at the 2014 Fall Meeting of the American Geophysical Union (AGU). Professor Don DePaolo will receive the Hess Medal, Professor David Shuster will receive the Macelwane Medal, and Professor Nick Swanson-Hysell will be presented with the William Gilbert Award for excellence in paleomagnetism. Professor Paul Renne will also be honored as a newly elected fellow of the AGU.

In the latest ranking of graduate programs by the US News and World Report, Berkeley was ranked third nationally for Earth Sciences. However, in the fields of Geophysics and Seismology, we were named the best graduate department in the nation. Our stature in Geophysics is bolstered by the return of Professor Mark Richards to academic duties after serving as Dean of Mathematical and Physical Sciences, and later Executive Dean of the College of Letters and Science. In this issue of the Alumni Report, Mark and colleagues briefly describe their current research.

Over the summer we began a new era in our advance field course (EPS 118). For many years this capstone course in our Geology Program had been sustained by the extraordinary efforts of Professor George Brimhall. With George's retirement we faced the difficult challenge of filling a pair of very big shoes. Only by engaging four faculty members in the instruction (Professors Doug Dreger, Michael Manga, Paul Renne and Steve Self), and hiring an additional instructor (Dr. Sean Mulcahy), were we able to meet this challenge. Students judged the new course a success and we look forward to extending the enrollment to include more undergraduates in the Geophysics Program.

Indeed, the Undergraduate Majors program continues to be a source of great pride for the Department with six specializations covering the full spectrum of activities in Earth and Planetary Science. The remarkable growth in the number of undergraduate majors reflects the expanding relevance of Earth and Planetary Science, as well as the heroic efforts of our former Student Affairs Officer, Catherine Pauling. These duties have now been taken over by Nadine Spingola-Hutton, who is working to continue Catherine's legacy.

We place a high priority on giving undergraduate students a research experience. It expands their appreciation of Earth and Planetary Science and helps to refine their career goals. In many instances these activities are made possible by Ramsden scholarships. These scholarships offer a meaningful and tangible way to assist the next generation of Earth Scientists. We are very grateful for the generous donations we receive to support to our undergraduate and graduate students, particularly at a time of diminishing institutional funding.

Our department's legacy is the success of its alumni and we like to share those activities with our community. Please ensure that we have your latest contact information so that you receive the updates. As always, it is a pleasure to thank Judith Coyote and Nadine Spingola-Hutton for making this Alumni Update possible.

Bruce Buffett

Department Faculty Research Activities

Allen, Richard M., Professor, Ph.D., 2001, Princeton University. Currently using seismic data from the offshore-onshore Cascadia Initiative to explore the formation, deformation and destruction of the Juan de Fuca plate from the ridge and through the subduction zone.

Alumbaugh, David L., Adjunct Professor, Ph.D., 1993, UC Berkeley. Completed a model resolution analysis of marine electro-magnetic exploration technologies currently being employed to de-risk petroleum drilling in deepwater environments.

Banfield, Jillian F., Professor, Ph.D., 1990, Johns Hopkins. Geomicrobiology, microbial ecology and evolution; nanoparticles in the environment.

Bishop, James K.B., Professor, Sc.D., 1977, MIT/WHOI Joint Program in Oceanography. Chemical, physical, and biological controls on the cycles of carbon and related chemical species in the ocean; robotic instruments for ocean exploration.

Boering, Kristie A., Associate Professor, Ph.D., 1992, Stanford University. Atmospheric chemistry and climate; field, laboratory, and modeling studies of the stable isotopic compositions of atmospheric trace gases; photochemical isotope effects.

Buffett, Bruce, Professor, Ph.D., 1991, Harvard University. Developed a stochastic model of magnetic reversals from a 2-Myr time series of paleointensity.

Bürgmann, Roland, Professor, Ph.D., 1993, Stanford University. Active tectonics. Explored earthquake triggering by tidal stresses, seasonal hydrologic loads and distant global earthquakes.

Chiang, Eugene, Professor, Ph.D., 2000, Caltech. Planet formation, protoplanetary disks, planetary dynamics.

Cohen, Ronald C., Professor, Ph.D., 1991, UC Berkeley. Studied the role of soils and fires in the atmospheric nitrogen cycle using space-based UV-visible spectroscopy.

Collins, William D., Professor in Residence, Ph.D., 1988, University of Chicago. Global climate models; interactions of sunlight and heat with the Earth's surface and atmosphere; applications of remote sensing to understand climate processes.

Cuffey, Kurt M., Professor, Ph.D., 1999, University of Washington. Glacier mechanics; paleoclimatology; environmental isotope geochemistry; river processes.

DePaolo, Donald J., Class of 1951 Professor of Geochemistry, Ph.D., 1978, Caltech. Currently working on isotopic fractionation during crystal growth, geochemistry of Tibetan granites, U ore deposits, and carbon sequestration.

de Pater, Imke, Professor, Ph.D., 1980, University of Leiden. Radio and infrared observations of the Solar System, including giant planet atmospheres and Jupiter's magnetosphere.

Dietrich, William E., Professor, Ph.D., 1982, University of Washington, Seattle. His research group showed experimentally the necessary conditions for sustained river meandering and presented a theory predicting valley spacing.

Dreger, Douglas S., Professor, Ph.D., 1992, Caltech. Wave propagation; earthquake source physics; earthquake hazards; realtime seismology; nuclear monitoring.

Fung, Inez Y., Professor, Sc.D., 1977, MIT. Climate change; global carbon cycle; geophysical fluid dynamics and large-scale numerical modeling; remote sensing of the Earth.

Ingram, B. Lynn, Professor, Ph.D., 1992, Stanford University. Published a book on the geologic history of floods and droughts (The West without Water, University of California Press). Recent research includes studies of ancient floods using sediment cores from San Francisco Bay and watershed.

Jeanloz, Raymond, Professor, Ph.D., 1979, Caltech, is using the largest laser in the world to reproduce conditions deep inside Jupiter and super-Earth exoplanets.

Manga, Michael, Professor, Ph.D., 1994, Harvard University. Published a book with Chi Wang on "Earthquakes and water" - showed that many hydrologic responses to earthquakes are caused by permeability changes produced by shaking.

Militzer, Burkhard, Associate Professor, Ph.D., 2000, University of Illinois. Predicted with computer simulations that water ice assumes a new superionic form in the interiors of Uranus and Neptune.

Pride, Steven R., Adjunct Professor, Ph.D., 1991 Texas A&M. Developed new models for how seismic waves can mobilize liquid pollutants and hydrocarbons trapped on capillary barriers in porous media and applied these models to a test site in Oklahoma.

Rector, Jamie, Professor, Ph.D., 1990, Stanford University. Seismic techniques for characterizing reservoir properties and processes; seismic reflection imaging; borehole seismology; near-surface seismology with applications to environmental remediation.

Renne, Paul R., Professor in Residence, Ph.D., 1987, UC Berkeley. Launched an NSF-funded project to build a "designer" reactor based on deuterium fusion to produce a high flux of nearly monoenergetic neutrons for Ar/Ar geochronology.

Richards, Mark A., Professor, Ph.D., 1986, Caltech. Mantle convection and large-scale mantle structure; dynamics of terrestrial planets; dynamics of global plate motions; regional crustal deformation and earthquake hazards.

Romanowicz, Barbara A., Professor and Director, Berkeley Seismological Laboratory, Doctorat d'Etat, 1979, Université de Paris. Used anisotropic wave-form tomography to reveal two distinct layers in the lithosphere under the North American craton.

Romps, David M., Assistant Professor, Ph.D., 2005, Harvard University. Our group uses theory, simulation, and observation of clouds and atmospheric dynamics to improve our understanding of Earth's climate.

Self, Stephen, Professor since 2012; PhD 1974, Imperial College, London, UK. Recently, explosive eruptions from New Zealand and the impact of volcanism on the atmosphere has occupied my research time. Began new collaboration with other EPS faculty on Deccan volcanism (India).

Shuster, David L., Associate Professor, Ph.D. 2005, Caltech. Developed a new geochemical paleothermometer based on production and diffusion of cosmogenic noble gases on earth and the moon, and studied timescales of Grand Canyon incision.

Swanson-Hysell, Nicholas L., Assistant Professor, Ph.D., 2011 Princeton University. Built a paleomagnetism lab in McCone Hall with automated sample changing and analysis capabilities. Developed new constraints on North America's rapid paleogeographic change 1.1 billion years ago.

Emeriti

Alvarez, Walter, Professor, Ph.D., 1967, Princeton University. Research in the Italian Apennine Mountains on Early Cretaceous Earth History and the tectonic origin of this unusual mountain range. Broader research on Big History and ChronoZoom (search for it on the web!).

Brimhall, George H., Professor, Ph.D., 1972, UC Berkeley. Completed geological mapping in the Pioneer Mountains of Montana where a Cretaceous formation bears evidence of early uplift of the Rocky Mountains.

Bukowinski, Mark S.T., Professor Emeritus, Ph.D., 1975, UC Los Angeles. Physics and chemistry of planetary interiors; mineralogy; high pressure mineral physics; planetary structure and evolution.

Johnson, Lane R., Professor Emeritus, Ph.D., 1966, Caltech. Seismology and physics of the Earth's interior and wave propagation; seismic source theory; applied geophysics.

Kirchner, James, Professor Emeritus, Ph.D, 1990, UC Berkeley. Showed that stream chemistry time series have a common fractal structure that makes water quality trends difficult to detect and predict.

Morrison, H. Frank, Professor Emeritus, Ph.D., 1967, UC Berkeley. Applied geophysics: electrical and electromagnetic methods for mapping subsurface conductivity; cross-well electromagnetics for reservoir characterization; numerical modeling and inversion.

Sloan, Doris, Adjunct Professor Emerita, Ph.D., 1981, UC Berkeley. History of San Francisco Bay, Foraminifers in Bay sediments, biostratigraphy

Wang, Chi-yuen, Professor Emeritus, Ph.D., 1964, Harvard University. Continued to work on problems related to earthquake-induced transport. Collaborated with Wang-Ping Chen using results from seismic tomography to constrain temperature beneath Tibet.

Wenk, Hans-Rudolf, Professor Emeritus, Ph.D., 1964, University of Zurich. Focus has been on anisotrophy in the deep earth--with high pressure experiments--as well as anisotrophy and preferred orientation in shales and returning to the enigmatic mechanical twinning in quartz.

Cosmogenic Noble Gas Paleothermometry

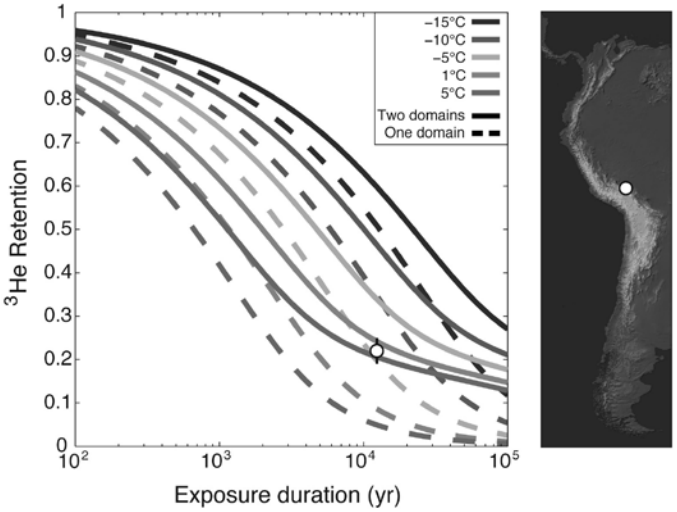
by David Shuster

In two papers recently published in *Earth and Planetary Science Letters* and *Geochimica et Cosmochimica Acta*, EPS graduate student Marissa Tremblay, Greg Balco (of Berkeley Geochronology Center), and David Shuster develop a fundamentally new form of geochemical paleothermometry (see *noblegas.berkeley.edu*). The method is based on the simultaneous production and thermally activated diffusion of cosmogenic ^{3}He and ^{21}Ne in common minerals such as quartz and feldspars exposed at Earth's surface. Despite a high production rate and relative ease of measurement, cosmogenic ^{3}He in quartz was entirely abandoned as a tool for surface exposure dating, since it was recognized in the 1990s to experience diffusive loss at surface temperatures on Earth. However, with quantitative knowledge of diffusion kinetics, the relative abundance of cosmogenic ^{3}He, ^{21}Ne and other cosmogenic nuclides in mineral samples provides a record of their integrated temperature histories during residence near Earth's surface.

In principle, the theory and mathematics of production and diffusion that have been applied to radiogenic noble gases in minerals can also be applied to cosmogenic noble gases. Important differences are in (i) the depth over which cosmogenic nuclides are produced (i.e., mostly within meters of the surface), (ii) the different nuclide-mineral pairs involved, and (iii) the potential for production rate changes (i.e., in contrast to steady parent nuclide decay rates). When compared to a cosmogenic nuclide that does not experience diffusive loss, a measure of the proportion of cosmogenic ^{3}He retained in a sample provides a measure of temperature during production (Fig. 1). Importantly, both axes in Figure 1 are observable, such that the effective diffusion temperature during a sample's surface exposure is constrained by observables.

This technique quantifies past temperatures and exposure histories of surface materials that can inform a broad range of scientific research. First, measuring exposure durations of surface rocks is important for understanding geologic processes that modify Earth's surface, including surface erosion, sediment transport, and earthquake-related surface deformation. Second, measuring past temperatures is important for understanding Earth's natural climate variability over timescales of 10^3 to $>10^6$ years. For example, such information is important to establish how past changes in environmental conditions influenced biota at various regions across the globe, and how past climate changes were potentially controlled by natural phenomena such as the gradual development of mountain ranges. However, our ability to quantify past temperatures is currently limited to a small number of geochemical techniques. This new method could provide an independent test of existing methods, and potentially benefit a range of research sub disciplines, including quantitative geomorphology, landscape evolution studies, late Cenozoic climate change, glacier and ice sheet change, and potentially paleo-elevation of actively uplifting landscapes.

As a test of the method, we initially studied a single quartz sample from a high elevation setting in Peru (Fig. 1). For this sample, a production and diffusion model that incorporates sample-specific, experimentally determined diffusion parameters predicts an effective temperature during the Holocene that is consistent with the mean modern temperature at the sample location. This internal consistency demonstrates that the laboratory-determined diffusion kinetics applies to cosmogenic ^{3}He and ^{21}Ne in this quartz over geologic timescales.



(Figure 1)
Retention of cosmogenic ^{3}He in a quartz sample collected from a moraine boulder from the Huancane Valley, Peru. The ^{3}He concentration and the sample-specific ^{3}He diffusion kinetics (i.e., used in the "Two domains" models) determined in Shuster's lab demonstrate that this sample experienced an effective diffusion temperature of 3.0 (+4.1/-2.9) °C during surface exposure. This diffusion temperature corresponds to a mean annual temperature of ~2 °C, which is in excellent agreement with the current mean annual temperature of the site. The surface exposure duration of this sample was determined by Kelly et al., 2013 using ^{14}C and ^{10}Be.

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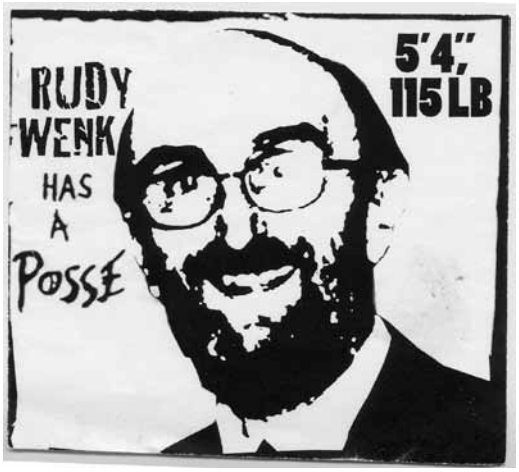
Fun with Retirement

by Hans-Rudolf Wenk

Time passes quickly. It has already been five years since I started as emeritus…translated from Latin: "out of service". But this is not quite accurate because I have never been busier in my whole life. No more excuses to relax at faculty meetings or shy away from some research project because I am too involved in teaching. Research has been fascinating, with wonderful collaborations on challenging subjects. Let me just elaborate on two of them.

One is related to the San Andreas fault, probably the most intensely studied fault system in the world, and discovered by our own Andrew Lawson. Rocks in earthquake rupture zones are generally thought to sustain only small stresses due to their low measured strengths. We investigated a sample of fault gouge from the Parkfield drilling project with microfocus X-ray diffraction at the Advanced Light Source synchrotron and observed in quartz crystal lattice distortions indicative of residual stresses up to 300 MPa, exceeding the macroscopic strength by an order of magnitude and likely being produced by a seismic shock wave. These seismic stresses are similar in size to those observed in quartz subjected to meteorite impact. The research establishes the microstructural features on the micron scale as a new paleopiezometer for deformed rocks.



Posters appear early one morning in McCone.

The second one has also to do with seismology, as well as linking microscopic features with macroscopic patterns. What produces the distinct anisotropic signature in the lowermost mantle of the Earth that has been characterized by Barbara Romanowicz? In a project that links large scale geodynamics, polycrystal plasticity, elastic properties and diamond anvil cell diffraction experiments (again at ALS) we could establish that preferred orientation of postperovskite is a likely explanation for the distinct seismic anisotropy pattern observed in the D" zone. It has been a project of PhD student Sanne Cottaar (now in Cambridge), with contributions from Pam Kaercher (now in Liverpool) and Eloisa Zepeda (still in Berkeley). Both projects illustrate that what goes on in crystals can be significant for the Earth and at the same time seismology can guide us to zero in on elementary processes. Pam and Eloisa are further exploring the interaction of different phases during deformation, which is significant for most rocks.

On the side I enjoy teaching freshmen seminars and getting students enthusiastic about earth sciences by taking them on fieldtrips. A view from Yosemite Point on a recent EPS 39 trip links petrology, glaciology, geomorphology and structural geology. But by far the most memorable event happened in April when one Monday morning the elevators in McCone Hall were cluttered with stickers "Rudy Wenk has a Posse", much to the dismay of the building manager. I had no idea what this was about and only began to appreciate it when colleagues began to express jealousy. It reminded me that the interaction with students is by far the most valuable part of an academic career. I was thinking of all the memories, from fieldwork in Idaho with my first student Gordon Nord where hunters were upset because we hit rocks with our hammers and chased deer away, to last year's Thanksgiving dinner in Chinatown with Jane, Pam and Eloisa in deserted Chicago, before starting experiments at the synchrotron.

[Cosmogenic Noble Gas Paleothermometry, continued]

A significant advantage of the method is related to the prevalence of quartz and feldspar at Earth's surface. Unlike other methods involving oxygen isotope observations in carbonate or ice, or pollen records preserved in sediments, cosmogenic noble gas paleothermometry can be applied near everywhere on Earth where bedrock is exposed. Further, the paleotemperature constraints are local rather than global. In principle, a spatial distribution of temperature reconstructions of continental settings should be possible over the last 10^3-10^7 years. Such information could inform models of time-varying climate sensitivity. For example, simply comparing a cosmogenic noble gas paleotemperature with the modern mean annual temperature will indicate whether there was a net cooling or warming at a particular location on Earth over a particular timescale. We are currently collecting data from sites across the globe as a first step towards constructing such records.

The Deccan Traps, the Chicxulub impact, & the K-T Extinction: A Happy Return to the Scene(s) of the Crime

by Mark Richards

I arrived at Berkeley in 1989, and in the same year published what was to become my most highly-cited paper, explaining huge volcanic events called flood basalts, such as the Siberian and Deccan Traps, as the consequence of the rising "heads" of new mantle plumes (see illustration). The trailing plume "tails" explain classic hotspot tracks such as Hawaii, Yellowstone/Snake River Plain, and La Réunion. Flood basalts are remarkable not only for their size (sufficient to cover California in more than 2 km of basalt), but also because of their correspondence in time with at least four of six major mass extinction events of the Phanerozoic—the Emeishan Traps and the end-Guadalupian (Middle Permian) extinction; the Siberian Traps and end-Permian extinction; the Central Atlantic Magmatic Province (CAMP) and the Triassic-Jurassic extinction; and the Deccan Traps and the Cretaceous-Tertiary (K-T) extinction, during which the non-avian dinosaurs disappeared. Apparently, these "endogenous" volcanic catastrophes have exercised a major influence on biological evolution.

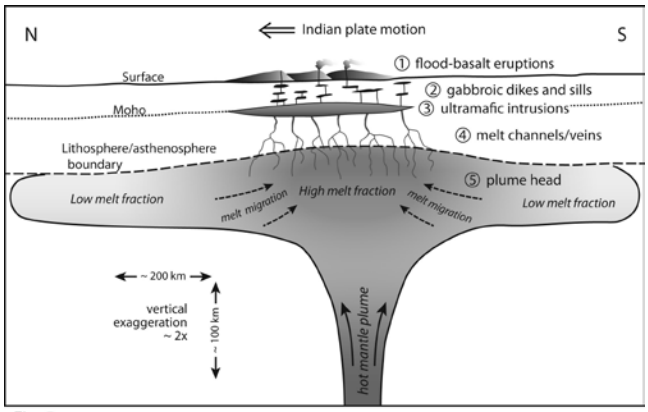


Fig. 5

Cross-sectional diagram of the Deccan plume head melting beneath the Indian subcontinent. Could the Chicxulub impact have caused a transient increase in the permeability of the partially-molten plume head, unleashing the enormous eruptions of the Wai Sub-group of the Deccan Traps?

But this serial murder mystery turns out to have a bizarre twist. Just nine years earlier, in 1980, Walter Alvarez and his colleagues had published a sensational paper in *Science* suggesting, on the basis of the famous K-T boundary iridium anomaly, that *T. rex* and friends had been done in by a meteor or comet impact. So at K-T time, we were faced with the paradox of two possible causes (impact and volcanism) for mass extinction occurring at about the same time.

Instead of contesting the merits of these causes, which has for the last three decades been the source of often acrimonious debate among some of our colleagues, Walter and I quickly became fast friends, and for 25 years we have searched together for an answer to this grand conundrum: Was this really just a bizarre coincidence? Could the impact have somehow caused the Deccan flood basalts? Was an environmental double-whammy required to exterminate the dinosaurs and 70% of all species in the fossil record at K-T time?

In time, evidence has accumulated largely on the side of an impact cause for extinction at K-T time. Most importantly, the famous K-T-age Chicxulub (Yucatán, Mexico) crater was discovered in 1991, due to some Indiana Jones-esque sleuthing of tantalizing clues of an immense tsunami and impact debris around the Caribbean region, a true geological smoking gun if ever there was one. And just last year Paul Renne's exquisite ^{40}Ar-^{39}Ar work on dating both Chicxulub and the K-T boundary at Hell Creek, Montana, showed that these two events occurred right at 66.04 Ma, within less than 30,000 years of each other—a mere wink of an eye in geologic time. In the mean time, it has become clear that the Deccan Traps were well underway at least several million years before K-T time, and therefore that the Deccan eruptions could not plausibly have been initiated by the impact. Thus the impact cause for the demise of *T. rex* has taken hold in the public eye—ask your children or grandchildren and they can probably tell you all about this.

Twenty-five years later, and after serving 12 years as Dean of Mathematical and Physical Sciences and as Executive Dean of the College of Letters and Science, I have returned now to the joys of being a full-time faculty member in the Department of Earth and Planetary Science, and, strangely, to the grand dilemma that remains regarding the Chicxulub/Deccan/K-T "coincidence."

You may ask, why would I revisit this question? Wasn't this all settled with the discovery and precise dating of the Chicxulub impact?

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Commencement 2014

BACHELOR OF ARTS

ATMOSPHERIC SCIENCE
Christopher Roland Theiss

ENVIRONMENTAL EARTH SCIENCE
Adam Patrick Cohen
Naya Olmer
Christian Manuel Ortiz
Jonathan William Ratner
Jeemin Hannah Rhim
Kevin Joseph Roth
Allison Gail Swartz
Abraham Zhan

GEOLOGY
Sara Estrella Beroff
Eric Jeffrey Bloss
Alexandra Chamberlain
Matt Hoffman
Alexander Leven
John Zihong Li
Izabela Sabina Novacka
Benjamin Joseph Paulus
Kat Powell
Patrick Allen Redford
Gunnar Speth
Andrew Joseph Tholt
Holly Rebecca Waite

GEOPHYSICS
Esther Rose Demsetz
Adelstein
Ara Albert Alexanian
Samuel Patrick Dennis Birch
† Voon Hui Lai
Aurora Ma Li Smedley

MARINE SCIENCE
Victoria Nari Khym-Campbell
Sonia Castillo
Amanda Elizabeth Chiachi
Kevin Le Kha
Maxtrillion Kyman
Catalina Sun Thompson
Emilia Wakamatsu
Addien Cavan Wray
Theresa Yi Wen Zhang

PLANETARY SCIENCE
Karen Alvarez
Giavanna Page

* with honors
† departmental citation

MASTER OF ARTS

Dylan McHenry Bland
Geologic Applications to Petroleum Systems

Danny Ng
Geophysical Fluid Dynamics

Student Activities

Eliel Anttila (Geology), Brittany Cliffe (Environmental Earth Science), Ellen Knappe (Geophysics), Tom Ogasawara (Geology), and Andrew Tholt (Geology): participated in a 2013 winter externship with the Global Student Embassy Program in Ecuador.

Cansu Culha, Geophysics: Participated in a spring semester field camp in Hawaii with Cornell University.

Kristina Duncan, Environmental Earth Science: Attended the American Indian Science and Engineering Society conference in Colorado.

Andres Hernandez, Geophysics: Participated in a winter externship field course with the University of Alaska on Volcanism and Active Geology of the Island of Hawaii.

Nicholas Tang, Atmospheric Science: Senior honors thesis with Civil and Environmental Engineering

Carlos Torres, Environmental Earth Science: Attended American Indian Science and Engineering Society conferences in Colorado and Hawaii. Worked with Dr. Oceana Francis at the University of Hawaii at Manoa on wind-generated waves.

Rebecca Trinh, Marine Science: Attended the Ocean Sciences Conference in Hawaii and the International Society for Behavioral Ecology Conference in New York.

Areidy Beltran, Environmental Earth Science: Attended the American Indian Science and Engineering Society conference in Hawaii.

Karen Alvarez, Planetary Science: Attended the NASA YSS Undergraduate Research Conference.

Michael Chamberlain, Geophysics: Participated in an REU program performing earthquake engineering research at Lehigh University.

Adam Cohen, Environmental Earth Science: Senior honors thesis research project titled “Determining the effectiveness of V* as an indicator of post-fire fluvial sediment transport.”

Jasmine Hawthrone, Marine Science: Participated in a volunteer program with the Hawaii Wildlife Fund in Maui, Hawaii.

John Li, Geology: Senior honors thesis research project titled “Using a Hornblende Thermo-barometer to Determine Granitoid Pluton Emplacement in the Benton Range, CA.”

Marine Science majors Jessica Kendall-Bar, Imari Walker Karega and Doriane Weiler: Completed research on the island of Mo’orea, Tahiti, studying the Geomorphology of Tropical Islands.

Doctor of Philosophy

Scott Winfield French
Global Full-Waveform Tomography Using the Spectral Element Method: New Constraints on the Structure of Earth's Interior

Zachary Michael Geballe
Melting and Freezing at the High Pressures of Planetary Interiors

Mong-Han Huang
Crustal Deformation During Co- and Postseismic Phases of the Earthquake Cycle Inferred from Geodetic and Seismic Data

Pamela Michelle Kaercher
Crystallographic Preferred Orientation and Deformation of Deep Earth Minerals

Hyojin Kim
Water Chemistry Evolution Through the Critical Zone

Daniele Rosa
Multiscale Global Atmospheric Transport and Convective Precipitation

Shuo Zhang
CO_2 Mineralization in Volcanogenic Sandstone Reservoirs for Geological Sequestration

Zhao Zheng (Allen)
Refining Constraints on Seismic Discontinuities and Elastic Structure in the Earth's Upper Mantle

Environmental Earth Science and Atmospheric Science

Back Row (L to R): Jonathan William Ratner, Christian Manuel Ortiz, Kevin Joseph Roth, Abraham Zhan, Adam Patrick Cohen
Front Row (L to R): Naya Olmer, Allison Gail Swartz, Jeemin Hannah Rhim, Christopher Roland Theiss

Geology

Back Row (L to R): Holly Rebecca Waite, Patrick Allen Redford, John Zihong Li, Gunnar Speth, Eric Jeffrey Bloss
Middle Row (L to R): Alexander Leven, Matt Hoffman, Andrew Joseph Tholt, Benjamin Joseph Paulus
Front Row (L to R): Kat Powell, Sara Estrella Beroff, Izabela Sabina Novacka, Alexandra Ariana Chamberlain

Geophysics

Back Row (L to R): Aaron Tran, Tom Ogasawara, Amanda Louise Atkinson, Ellen Knappe
Front Row (L to R): Aurora Ma Li Smedley, Samuel Patrick Dennis Birch, Voon Hui Lai (Department Citation), Esther Rose Demsetz Adelstein

Marine Science & Planetary Science

Back Row (L to R): Addien Cavan Wray, Karen Alvarez, Maxtrillion Kyman
Middle Row (L to R): Sonia Castillo, Theresa Yi Wen Zhang, Catalina Sun Thompson, Amanda Elizabeth Chiachi
Front Row (L to R): Giavanna Page, Victoria Nari Khym-Campbell, Kevin Le Kha, Emilia Wakamatsu

PhD & Master of Arts

Back Row (L to R): Shuo Zhang, Daniele Rosa, Zachary Geballe, Pamela Kaercher, Dylan Bland
Front Row (L to R): Scott French, Hyojin Kim, Allen Zhang, Mong-Han Huang, Danny Ng

Alumni Notes

1952

Edward Margason – B.A. Geology: After graduating I served as a Naval Petroleum officer then worked in formation oil well logging for 4 years. I next obtained my BS in Civil Engineering and graduated from Berkeley in 1963 with an MS in Civil Engineering and Soil Mechanics. I worked with a San Francisco-based Geotechnical Consulting firm for 24 years registered as a Civil and Geotechnical Engineer and also as a licensed Geologist and Engineering Geologist. I developed foundations design criteria for many of the Bay Area high-rise buildings as well as for earthwork and rock stabilization projects throughout California. Since 1983 I have had my own consulting firm specializing in soil and rock mechanics and expert witness assignments relating to construction claims and changed underground conditions. I retired to Santa Rosa in 2004 to spend more time with my family and grandchildren and to pursue divers hobbies such as faulty trench studies, travel, model railroads and remote-control model airplanes and drones.

1967

Richard T. Buffler – P.h.D Geology: I continue to live full time in Santa Fe, New Mexico. I am sad to report that my wife of 52 years, Patricia passed away unexpectedly on Sept. 26, 2013. We miss her dearly.

1972

Kenneth L. Howard, Jr. – Ph.D. Geology: Still Teaching undergraduates and just promoted to full professor. Also serving as President of the faculty association and as Institutional Effectiveness Lead for the Math & Science Division. What research that I do anymore, focuses on effectiveness of science teaching, scientific literacy, and effective assessment of student achievement.

1968

James W. Murray – BA Geology: This past year I organized a Union Session at the Fall AGU and a Pardee Session at the GSA meetings on "Fossil Fuel Production, Economic Growth and Climate Change". A feature article was published in the AGU newsletter – EOS.

1953

Giles Maloof – BA Geophysics: I took a class from Byerly, Curtis & Turner. Louderback still appeared on occasion, long beard, leaning heavily on a cane. I have continued teaching as emeritus faculty at Boise State: differential equations and statistics.

IN MEMORIAM: Mr. Raymond F. Gray BA Geology '51, MA Geology '53

[The Deccan Traps, the Chicxulub impact, and the K-T Extinction: A Happy Return to the Scene(s) of the Crime, continued]

Well... it turns out that new evidence suggests a scenario that seems to have escaped our imagination previously, and which holds promise for reconciling the confounding Chicxulub/Deccan coincidence at K-T time. New work suggests that within the Deccan Traps flood basalt sequence, which covered most of northwestern India in up to 3.5 km of basalt about 69-65 million years ago, there was a particularly large set of eruptions, comprising the "Wai Sub-group" lava formations. These formations may account for more than 70% of the entire volume of the Deccan Flood Basalt Group, and from a variety of geological clues they appear to have erupted right at about K-T time. Within the Wai Sub-group, the Ambenali and Mahabaleshwar formations include the longest (~1000 km) and largest (~10,000 km^3) lava flows mapped on Earth, without which the Deccan Traps would probably not be considered a major flood basalt event at all.

This new evidence then raises an exciting new possibility: Could the Chicxulub impact have triggered these immense Wai Sub-group eruptions *during* the Deccan sequence, and did these eruptions contribute substantially to the K-T extinction? Working mainly with colleagues here at Berkeley (Walter Alvarez, Paul Renne, Michael Manga, Steve Self, and graduate student Courtney Sprain), we have begun to dive head-first into exploring this hypothesis on two fronts. First, we are trying to determine from a theoretical and observational standpoint whether seismic shaking from the Chicxulub impact, perhaps equal to a magnitude 11 earthquake, could have triggered volcanoes worldwide, including the Deccan Traps, which appears to be quite plausible. Second, we are also gathering new field data on the Deccan flood basalts in India. On the latter score, the weak link in all the evidence available is that very little high-precision radioisotopic dating work has been done on the Deccan lavas.

In March of 2014, a group of us (see photo on page 11) embarked for two weeks of careful sampling of the Deccan lava stack in the region of India near Mumbai,

[continued on page 11]

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[The Deccan Traps, the Chicxulub impact, and the K-T Extinction: A Happy Return to the Scene(s) of the Crime, continued]

Pune, and Mahabaleshwar. Our primary aim was to obtain high-quality samples for precise ^{40}Ar-^{39}Ar dating in order to determine, among other things, whether the immense Wai Sub-group lava flows did or did not occur immediately following the Chicxulub impact.

It takes at least 4 months to irradiate and cool these kinds of samples, and their analysis at Paul Renne's Berkeley Geochronology Center is now imminent, so as I write this article we are anxiously awaiting the results. Will these new data support what just a few years ago would have been considered an outrageous hypothesis? Will they show instead that the very largest Deccan eruptions instead preceded K-T time, adding to evidence that it was the Chicxulub impact, and not flood volcanism, that caused the K-T extinction? Or, as so often happens, will the new data throw us a curveball and suggest yet another scenario that we have not yet guessed? Stay tuned…

Steve Self, Paul Renne, Mark Richards, and Courtney Sprain (left to right) with the Wai Sub-group lava formations in the background, near Mahabaleshwar, India.

Department Funds

Esper S. Larsen, Jr. Research Fund

Formally established on October 31, 1989. The proceeds of an endowment left to the University by Eva A. Larsen are used to support new research in the fields of geology, mineralogy and petrology. 2013-2014 recipients were:

Jim Bishop
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Friends of Earth and Planetary Science Fund

Established in 2007 to solicit funds for emergency student aid, collegial activities in support of education and research as well as equipment and facilities upgrades; to help with costs for student activities such as field trips and the yearly Santa Barbara's Day event; to make a monetary award to the winner of the Departmental Citation; to support alumni outreach; to defray the costs of the weekly departmental Speaker's Program in which distinguished speakers from around the country are invited; and to assist in the acquisition of journals for the Earth Sciences Library and Map Collection.

To donate, see http://eps.berkeley.edu

Memorial Funds

Perry Byerly Fellowship Fund: Established in 1978 to honor the memory of Perry Byerly with a graduate fellowship in seismology.

2013-2014 recipients: William Hawley & Avinash Nayak

Don Tocher Memorial Fellowship Fund:
2013-2014 recipient: Avinash Nayak

Ramsden Scholarships:

Established in 1994 to support undergraduates who have expressed an interest in preparing for careers in the geosciences. In 2013-14 the Fund awarded a total of $40,00 to deserving undergraduates; $6,000 to support independent research, $2,500 for field camp support, $16,000 to help 8 students attend winter research externships in places like Equador and Hawaii, and $15,000 in general financial support.

Fellowship Letter of Appreciation

I am a 3rd year graduate student in the department of Earth and Planetary Science. I am extremely honored and grateful to have received the Tocher Fellowship from Berkeley Seismological Laboratory in Fall 2012. The Tocher fellowship is named after Don Tocher (1926-1979), a prominent seismologist who had contributed significantly to the installation of the first regional seismic network telemetered by commercial telephone lines while working at the Berkeley Seismographic Stations during 1956-1964. This fellowship fully supported my tuition, salary, all academic fees and health insurance during my first year. It took care of all of my financial necessities and allowed me to devote all my efforts and time towards academic and research activities. Additionally, this fellowship was not constrained to any specific research topic, permitting me to work on multiple interesting and evolving research problems without funding during the course of the year. This has resulted in one publication in a peer-reviewed journal and submission of proposals to USGS and NSF for taking the work further with implications for induced seismicity and seismic monitoring. A one-time grant of $3000 was also a part of this fellowship, which covered my relocation costs from India to Berkeley and allowed to purchase a top-tier laptop. I am using this computer as a tool to run computationally demanding software and applications vital to my research work, as well as for coursework. The Tocher Fellowship was a major blessing and an immense pillar of support in my initial year in graduate school and I am very thankful to all donors who have contributed to this fellowship for previous students and me. We really appreciate and hope for continuing financial support, which is extremely helpful to students. ~Avinash Nayak

2013-2014 EPS Staff

(Front row, L to R): Nadine Spingola-Hutton, Margie Winn, Clarissa Foreman, Crysthel Catambay, Charlie Paffenbarger

(Back row, L to R): Niraj Raman, Jann Pagdanganan, John Werner, Raluca Iordache, Tim Teague, Judith Coyote, Micaelee Ellswythe

To Our Alumni,

Thanks to those of you who provided updates for our report this year. We are always glad to hear from you, so do not hesitate to keep in touch. We also thank those of you who contacted us about support for our undergraduate program. As most of you are probably aware, state funding for UC Berkeley remains under pressure. For this reason we have become more reliant on gifts from generous alumni who are now in a position to give back to the current student body. Alumni gifts currently provide support for undergraduate teaching, research and fieldwork, as well as graduate student fellowships for research and fieldwork. This past year we were especially grateful for the generous contributions from Phil Behrman and Tom Welsh.

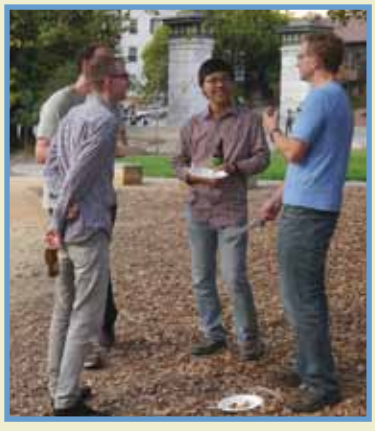
This fall we come to you with a specific request for help. The number of undergraduate majors in EPS has grown remarkably over the past few years, reflecting the growing importance of our discipline. However, this growth places a strain on our resources. More than 40 students enrolled in Mineralogy (EPS 100A) this fall. This popular course gives student hands-on experience and valuable skills for future employment. Tim Teague has done wonders keeping the aging microscopes working, but time and use has brought these instruments to the end of their functional lifetime. So, we are asking you to consider making a gift of any size to our Friends of Earth and Planetary Science fund with a note that the donation be used toward the purchase of new microscopes. For more information about this effort please contact **epsalumni@berkeley.edu.**

2014 Department Barbeque

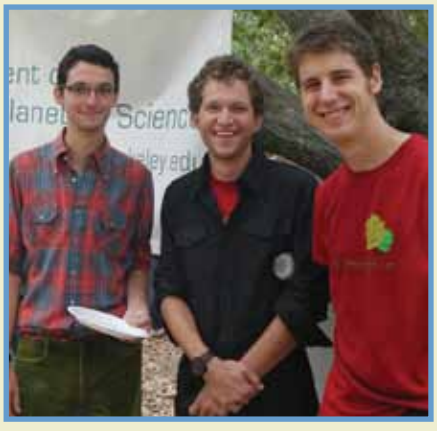
Photos by: Margie Winn

Chelsea Willett, Alex Bryk, Michael Antonelli (Grads)

EPS Community



Kevin Driver, Francois Soubiran & Shuai Zhang (Post-docs); Burkhard Militzer (Professor)



William Hawley, Noah Randolph-Flagg, Jake Edman (Grads)

Marco Calo & Mong-Han Huang (Grads); Horst Rademacher (Visiting Professor); Peggy Hellweg (BSL Operations Manager)

EPS 39 freshmen fieldtrip, April 2014. View from Yosemite Point

EPS 118 field trip, Spring 2014

EPS 118 field trip, Spring 2014