Earth and Planetary Sciences at UC Santa Cruz

Fall 2011

Summer Field 2011

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Chair's Welcome

Dear Alumni and Other Friends,

While state funding for the University of California is in decline, and tuition (yes, we call it that now---fees are an anachronistic term viewed with nostalgia) is perpetually going up, the Earth and Planetary Sciences Department is, by any measure, doing really well. We're educating lots of students, the research of the department continues to be super-high-profile, our departmental ranking is in the top-15 among earth sciences departments in the U.S. in any survey at which one cares to look (or believe), and our faculty keep getting major awards. A few highlights: Erik Asphaug made international news, including front page stories in obscure outlets like the L.A. Times and Denver Post, for his simulation of the formation of the anomalous far side of the moon from a collision between two proto-moons. Emeritus (but still way active) faculty Casey Moore won the International Prize of the Geological Society of Japan as a tribute for his 38 (!) years of work on Japanese subduction zones (including lots of collaborations in Japan). Jim Zachos was elected a Fellow of the American Academy of Arts and Science for his manifold paleoceanographic contributions, along with other luminaries (including, oddly enough, Bob Dylan). Between our junior and senior classes, we have 185 declared majors (the largest number of Earth Sciences majors in our history, as well as within the UC system). And, our lower division enrollments indicate that roughly half of our ~15,000 undergraduates take an EPS class at some point during their stay on campus. So, we're educating more students than we ever have (and the students are, sadly, paying more than they ever have), but the Department continues to thrive in the face of institutional fiscal challenges and dismaying cutbacks.

Finally, we've had staffing shifts in the last year: long-time undergraduate and graduate program coordinator Cathy Smith took a well-deserved retirement, and Jennifer Fish (who many of you know from her time as front office Manager) has taken over as our graduate program coordinator. Oh, and there's also been a leadership transition in the Department: Paul Koch spring-boarded from the Chairship of our Department to become the Interim Dean of the Division of Physical and Biological Sciences, and I became the 16th Chair of the Department of Earth and Planetary Sciences in this peculiarly Dickensian 'best of times, worst of times' period. Congratulations (we think) to Paul in his new role!

We hope that all who can will make it to our annual alumni/current folks event during AGU week at the Thirsty Bear ("San Francisco's first and only organic brewery": Tuesday, December 6th, 6 p.m., 661 Howard St.), and if you're in Santa Cruz, do stop by the Department!!

Quentin Williams, Chair

Paul Koch

Jim Zachos

Jim Gill

Slug Web Corner

Science Sort Of (http://www.sciencesortof.com), a weekly podcast on science (Patrick Wheatley & Charlie Barnhart)

Amelia Lyons' blog on work in rural Uganda http://gypsyclicks.blogspot.com/

Department News

Paul Koch has been appointed interim Dean of the Division of Physical and Biological Sciences at UCSC, effective July 1, 2011.
Jim Zachos was elected a fellow of the American Association for the Advancement of Science.
Jim Gill has received a Humboldt Research Award from the Alexander Humboldt Foundation of Germany, and will use this award to carry out research at IFM-GEOMAR in Kiel.

Kathryn Sullivan has been nominated by President Barack Obama for the post of assistant secretary of commerce. She graduated from UCSC in 1973 with a bachelor's degree in earth sciences; as a member of the NASA astronaut corps, she became the first U.S. woman to walk in space in 1984.

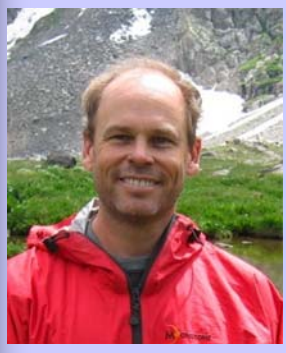
Emily Brodsky, associate professor of Earth and planetary sciences at UC Santa Cruz, is among the distinguished speakers featured in the National Science Foundation's "Voices From the Future" lecture series.

Francis Nimmo and co-workers reported on evidence for a subsurface magma "ocean" on Jupiter's moon Io in a paper in *Science*.

In an Article in Planetary and Space Sciences, undergraduate **Ashley Gilliam** says that planets around dim red dwarf stars could have liquid methane oceans, which are potential habitats for alien life.

In an article published in Journal of Geophysical Research, Grad student **Jake Walter** reports that the Honshu earthquake affected the flow of Antarctic ice streams.

Two Moons for the Price of One, by Erik Asphaug



Erik Asphaug

Every Thursday we have Planetary Lunch, an informal brown bag seminar where we talk about a paper that's about to come out, or some other scientific discovery or curiosity – in our solar system where spacecraft are zipping about, or in the increasingly bizarre menagerie around other stars. You're invited!

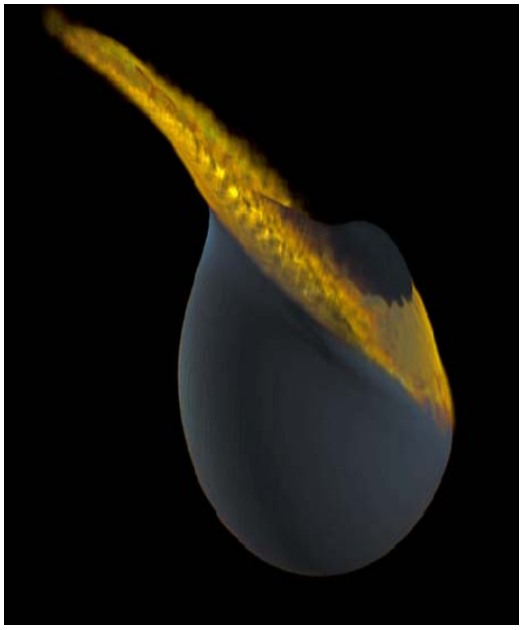
One day last year our curiosity turned to the enigmatic far side of the Moon. Professors Ian Garrick-Bethell and Francis Nimmo had a paper about to come out in *Science* showing that the farside has a broad-scale topography that can be fit by a degree-2 harmonic – something you might expect from tidal deformation. The amplitude of this far side bulge would require a mega-tide, something frozen into the lunar crust billions of years ago when the Moon was much closer to the Earth – a substantial finding for the dawn of Earth history.

A fundamental puzzle had us scratching our heads: Earth's tides would raise bulges on both sides of the Moon, whereas the near side is mostly flat, covered in volcanic plains – the 'man on the Moon'. Was there a near side bulge that got destroyed? That's a lot of rock to disappear! My thoughts began to drift… then I glanced towards Martin Jutzi, a postdoc from Switzerland who is now back at the University of Bern, and made a gesture of my palm colliding with my fist, and he kind of shrugged, as if to say 'sure, why not?

'Martin knew exactly what I meant, because just that week we had been modeling Mike Belton's 'splat' theory for the global-scale layered structures apparent in high resolution images of cometary nuclei. Belton, a leading figure in comet geophysics and space exploration, had published a geological interpretation that comets accreted like so many sloppy snowballs flung together. His theory had fallen out of favor, and we wanted to give it the benefit of some modeling.

And so as luck would have it, a few days earlier Martin and I had obtained the interesting result, that if comets consist of piles of porous ice, then you can indeed grow them splat by splat, like building a cob wall. But the collisions cannot be much faster than escape velocity – only a few meters per second for a ~10 km diameter comet – for otherwise you crater them or disrupt them instead of piling on a layer of material.

As soon as planetary lunch ended we went back to the lab to set up the initial conditions for a new simulation that would make a 'big splat' on the Moon. How big do we make the impactor? The simplest hypothesis would be to match the excess thickness of the farside crust– about 50 km spread out over one hemisphere – as a single splat; that's equivalent to a 1300 km diameter sphere. How fast do we make the collision? Too fast and we'd make a giant crater, or even disrupt the Moon, so we set the impact velocity equal to lunar escape velocity, 2.4 km/s. It was easy enough to set up, and we launched the run on the 'pleiades' supercomputer here on campus that afternoon, and went home.



Two moons, accreting. The impacting moon, an escaped Trojan co-orbital, is cold and solid by this time, while the Moon, about 30 times as massive, has a melt layer (colored yellow) that gets splashed to the other side. It would have been fun to watch – a day-long spectacle! Jutzi, M. and E. Asphaug, Formation of the lunar farside highlands by the accretion of a companion moon. *Nature* **476**, 69-72 (2011).

Garrick-Bethell, I., F. Nimmo, and M.A. Wieczorek, *Science* **330**, 949-951 (2010)

The result came back a few days later, and looked fairly similar to the figure you see here, which (little did we know) would eventually go viral and grace the cover of my Mom's paper the *Denver Post*, and also the *Sentinel* and the *LA Times* etc., and would appear in magazines and websites worldwide. We thought, 'wow!' Now, numerical modeling can be overly convincing with pretty pictures, so you have to check that your answer is physical. We were comforted by the fact that impact crater scaling, for this energy and momentum colliding into the Moon, predicts a crater only ~1/5 the volume of the impactor. There being much more impactor than there is crater, you'd expect a pile. Encouraged, we got the idea of putting in a deep melt layer and running the model at higher resolution. Petrologists think the Moon cooled from a magma ocean, and the last melt to solidify was enriched in potassium, rare-earth elements, phosphorus, uranium and thorium – incompatible elements ("KREEP") partitioned to the final melts. Curiously, only the near side of the Moon has large-scale expressions of KREEP-rich basalts, so we figured this layer ought to be part of the story.

This run took over a week, and by the time it had finished we had started putting together the framework of a hypothesis. An impacting body about 1/30 the mass of the Moon, colliding at subsonic velocity, lays down a thick layer of cold rock, quenching the geologic evolution on one hemisphere. In the process it displaces the KREEP to the opposite side – like dropping a ripe melon onto a cream-filled crepe. The model could explain three global asymmetries of the Moon: topography (the thick farside crust), composition, and geologic activity. We performed a fit to the final crustal thickness profile in our higher resolution model, and came up with a good match to the key observation of a degree-2 harmonic.

There is an excellent book called *The Big Splat* (Wiley, 2003) by local Santa Cruz author Dana Mackenzie, which is a historical telling of the origin of the Moon and the idea of the Giant Impact. Reporters started calling our idea the Big Splat, perhaps recalling Dana's title, and it stuck. We call it the *two moons* hypothesis.

But we faced some pretty serious obstacles. For one thing, the Moon is not all that compositionally diverse. In fact it's pretty much all anorthosite, the kind of rock you'd expect from the cooling of the magma ocean; the compositional dichotomy is subtle. Wouldn't an impactor striking the Moon be of a more primitive, asteroidal composition? Worse, where would such a large, slow impactor come from?

I had been aware of a series of papers by Matija Cuk (now at the SETI Institute in Mountain View) concerning the evolution of possible co-orbitals of the Moon – satellites that might have been formed alongside the Moon during the original Giant Impact. Such 'Trojan moons' are not unusual – some of the satellites of Saturn are co-orbitals, leading and trailing a larger satellite in its orbit. Matija had been trying to explain the Late Heavy Bombardment (LHB) of the Earth and Moon – an event which bombarded us at up to 10,000 times the current rate for a relatively brief span starting about 4 billion years ago – as the result of such a Trojan moon going unstable and breaking up tidally into a large population of bombarding projectiles. It was a huge hypothesis: it would mean that the LHB was a local, not solar-system wide phenomenon. But he was unable to satisfy his hypothesis, calculating that the instability would have occurred much earlier, around 4.4 billion years ago: as the Moon recedes from Earth, the Trojan points become unstable, and this happens about 400 Ma before the LHB.

This was the piece of the puzzle that went 'click'. We could have our cake and eat it too. A Trojan moon is not an unexpected outcome of giant impact simulations, and once it goes unstable it is likely to impact the Moon. The question is not so much 'if' but 'when', and also, 'how big?', and 'one or two?' Co-orbitals formed in the same giant impact are likely to have a composition similar to the Moon. Being smaller, they solidify quickly, and therefore after ~100 Ma a two-moon collision would involve a solid smaller moon impacting a mostly solid larger Moon possessing a liquid KREEP-rich layer, similar to what we've modeled. Being 'slow' by cosmic standards (the average impact velocity of asteroids and comets hitting the Moon is about 15 km/s), the collision would be subsonic, resulting in no impact shock and not a lot of melting. Think of it as a gargantuan cataclysmic landslide from space.

Continued on Page 6

Two Moons for the Price of One, continued

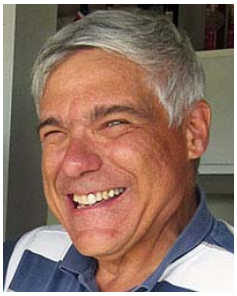
The collision would probably knock the Moon out of synchronous rotation, but it would not take long for tidal friction to grab hold of the now-lopsided Moon and lock it into the configuration we see today. We're left now to address the deeper questions: how would the cold lid on the farside affect the Moon's subsequent thermal and convective evolution? Since Trojan moons come in pairs, is there evidence for a second 'splat', or did the second one miss the Moon? Will seismology or gravity be able to discern the layered boundary our model predicts, between the original Moon and the new layer? What can the hypothesis, if true, tell us about the origin of the early Earth, which locked the system into a co-orbital configuration and evolved it outwards with time? Can it help us resolve the still-much-debated Giant Impact hypothesis? With precise data showing the Moon to be largely identical in oxygen isotopic composition to the Earth, these models have lost some of their credibility, since the Moon forms mostly from the impacting planet, not from Earth material. But one gets the idea that these are final details. The story might soon fall into place, and we'll know something certain about the birth story of the Earth.

Martin and I have fielded our share of questions regarding our two moons idea, most of them from the public via our recent press adventure. Most questions are not from scientists, who will debate it like any other hypothesis for decades, especially seeing as the GRAIL mission has begun mapping Moon's detailed gravity field, possibly to knock our model from its perch. Most questions come from people interested in the Moon for personal, cultural, or artistic reasons. The Moon is our planet beyond Earth that accompanies us on walks; we care about it instinctively. My baby, first noticing the full moon one night, pointed and said 'Ta Ta!' – it is a goddess. Muhammad, it turns out, once split the Moon in two. So look up in the sky, have a good look with a pair of binoculars if you'd like, and think about how amazing it is to be orbited by a planet that humans have walked on, and whose surface existed long before Earth's. The Moon is more important to the evolution of Earth, and life on Earth, and to the trajectory of human history, than we probably realize.

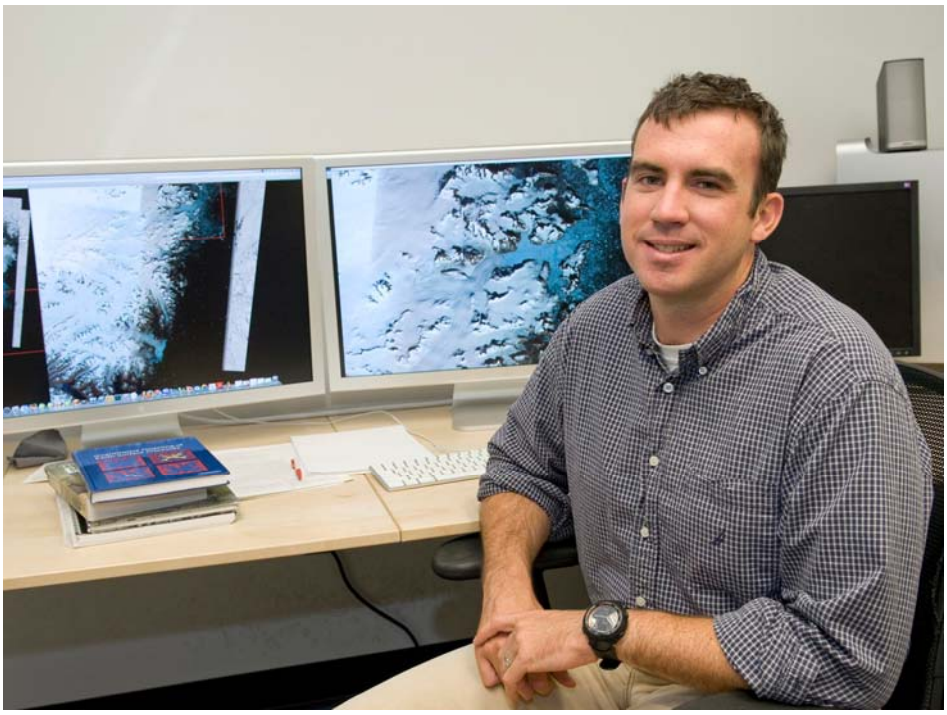
Casey Moore wins international prize of the Geological Society of Japan

The Geological Society of Japan has awarded its International Prize to **Casey Moore**, emeritus professor of Earth and Planetary Sciences. Casey contributed the prize money of 100,000 Yen back to the GSJ to support earthquake recovery efforts from the Tohuko Earthquake and tsunami. He gave a special lecture during the society's fall meeting in September. Casey has worked with Japanese scientists since 1973 as part of the Deep Sea Drilling project, and his collaborations continue today through his ongoing studies of fluid behavior in the Nankai trough subduction zone.

Jack Wendte, Ph.D. 1974 with **Bob Garrison**, was awarded the 2010 Medal of Merit by the Canadian Society of Petroleum Geologists. The Medal of Merit is presented to the authors who present the most highly regarded paper on Canadian petroleum geology. After UCSC Jack worked in the oil industry for 17 years and in 1991 joined the Geological Survey of Canada, where he continues a productive career.



Alum Ian Howat Awarded PECASE



UCSC alum **Ian Howat**, (**Ph.D., 2006; now assistant professor, School of Earth Sciences, Ohio State University**) has received a Presidential Early Career Award for Scientists and Engineers (PECASE) (awarded at a dinner at the White House on October 14, 2011). The PECASE is the highest award given by the United States government to science and engineering professionals in the early stages of their independent research careers. Howat studies the state of the Earth's large ice sheets, using data collected from space satellites as a primary observational tool. Howat's study appearing in the journal *Geophysical Research Letters* in May, 2011, refined the way ice loss in Greenland is measured. It provides a "high-definition picture" of climate-caused changes showing that in the last decade, two Greenland glaciers have lost enough ice to fill Lake Erie.

We hope to see you at the Thirsty Bear Brewing Company for our
11th Annual UCSC Earth & Planetary Sciences Alumni Event at Fall AGU!

When? **Tuesday, December 6, 2011**
from 6:00pm - 8:30pm

Where? **Thirsty Bear Brewing Company**
661 Howard Street, San Francisco, CA 94105
http://www.thirstybear.com/

Editor: Eli Silver

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Steve Ward

Tsunami SWAT Team – Not me.

Steven N. Ward, IGPP Research Geophysicist

In my lectures, I always claim that major Pacific---wide tsunami visit about once per decade. Almost surely, the 2011 wave from Japan will take this decade's prize. And me? I pretty much slept through the whole thing.

The massive Tohoku quake occurred at 9:46 PM Santa Cruz time when already I had been long in the sack. Next morning I wake to discover an email inbox crammed with requests for information and interviews on the "Japanese Tsunami". [No, I'm not famous; rather, small town Santa Cruz finds short the list of tsunami scientists to hit on when these things happen.] YIKES!, the biggest tsunami in years and I know nothing of it. On goes the TV and every channel is broadcasting the most spectacular inundation footage imaginable. In those lectures I describe tsunami as "The ocean turns into a river". And there it was! — Japan's afternoon traffic helicopters have just filmed that ocean---turned---river. "Man, I'd better get to the office." I skip breakfast but take time to put on a clean collared shirt. I know from experience, likely someone will be poking a camera in my door today.

By the time I drive down from Bonny Doon and turn into UCSC's west entrance, a line of cars stretch along Empire Grade in front of the University. Dozens of binoculared people stare toward the ocean a mile or more away perhaps hoping to witness a doomsday wave from high ground. "Today is going to be a zoo", I mutter.

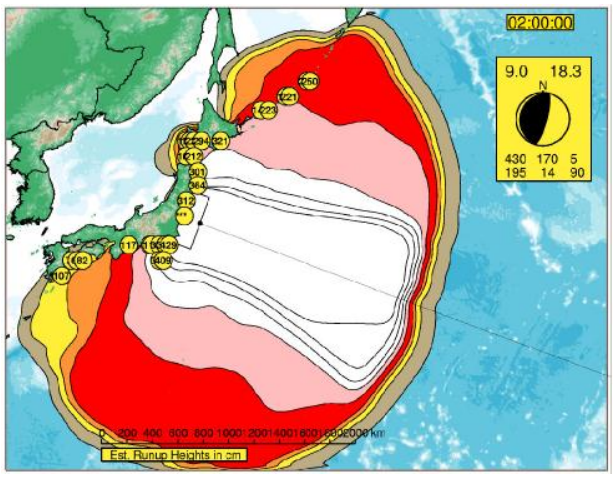

Figure 1. "Quick Look" tsunami calculation at T=2 hours after the Tohoku earthquake. Colors represent expected run up in 50 cm intervals. Largest run ups in the simulation top 10 meters directly adjacent to the fault. Tsunami always radiate most strongly in the direction perpendicular to the strike of the fault. This "flashlight beam", as I call it, is clearly evident heading toward southeast.

For the past years it has been my custom to run "Quick Look" tsunami simulations and post them on the web within an hour or two of major quakes. [Examples included here as Figure 1 and 2. Also see http://es.ucsc.edu/~ward/]. To make runs quickly on my laptop, I use several short cuts that those "official" Tsunami Warning Centers won't touch. Too, I rely on preliminary information on the quake's magnitude, location, physical dimension and focal mechanism. Early on these can be sketchy, but because eight hours have elapsed already, that information is nearly old hat. In fact by now, my colleague down the hall, Thorne Lay – the fastest seismologist I know – probably has written and submitted two GRL papers on the quake. Anyway, I post my first "Not---So---Quick Look" on the web by about 9AM and bare my prediction to the world. Will Santa Cruz get wet? I'm suggesting runup here between 1 to 2 meters (Figure 2) and soon we'll know. The wave ought to be making entrance to Monterey Bay just about now.

Back at my office, by 10 or 11 AM, reports of damage to Santa Cruz harbor begin to emerge. All morning I fielded calls from the press wanting instant analysis. [Funny. People believe that I'm part of some "Tsunami SWAT Team", sleeping in my socks with boots open next to the bed, ready to leap up and out at moment's notice when tsunami strike. I hate to disillusion those callers, but I get most information from Google like everyone else.] By noon, in spite of some scary TV footage of waves and currents in the Small Craft harbor, it looked like my 'Quick Look' prediction of a meter or two wave here will hold true. "Whew, could be just luck" I think to myself.

There is a personal side to this story beyond me Rip--Van--Winkle--ling. My second daughter Erica teaches High School English in Japan. She lives on Honshu's northeast coast in the little town of Kuji City, Iwate ---- at the northern edge of the 2011 rupture zone. I visited Kuji in October 2010 and gave a public lecture there on -- of all things – tsunami. Erica translated to Japanese naturally. The mayor and all the city bigwigs came. I found Kuji City much like Santa Cruz – 50,000 folks, mountains behind, ocean in front, and a river flowing through. The main residential town locates at the base of hills about mile back from the sea. Down toward the flats the commercial/industrial area hosts Home Depot and McDonalds. Further down still, a massive tsunami wall surrounds the harbor and fish mart. A week before the big quake, a M7 one hit offshore and a 10 cm sea wave was recorded in the area. Erica Skyped that she felt the shaking and I joked "Let's hope that this is not a foreshock of a M8." Little could we imagine that it actually portended a M9.

------Two nervous days went by before we received word from Erica. Locating the only working internet computer in Kuji, she wrote "Lower section of town wiped out, but all is O K with me".

------While Santa Cruz escaped a doomsday wave, it prompted me to make the affair a teaching moment through a "What If" computer simulation. What if Santa Cruz actually was struck by a tsunami like the one that hit Japan? I titled the movie "Tsunami Santa Cruz" and uploaded the three---minute thirty---seven second extravaganza to YouTube http://www.youtube.com/watch?v=BELavEvImYo. If you find that link too hard to type, just search for "Ingomar200", my YouTube Channel. I don't want to give away the plot, but for alums who still remember Santa Cruz geography, all I'm going to say is that "Beach Hill becomes an Island."

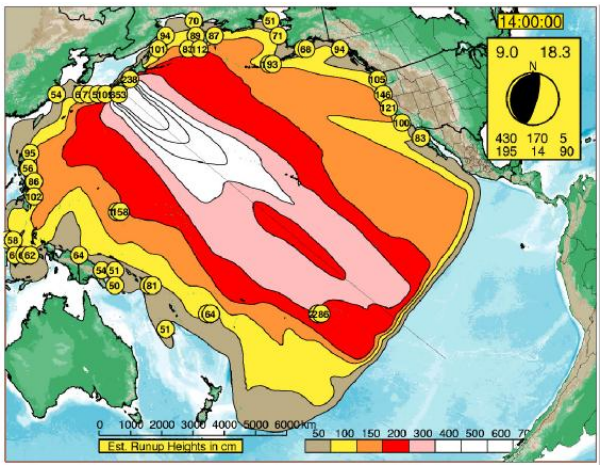

Figure 2. Quick Look tsunami calculation at T=14 hours after the quake. Note the "flashlight beam" cutting across the Pacific. On either side of the beam, expected inundation should be less. On the west coast of the United States, off the beam, the calculation predicted 1 to 1 1/2 meters of runup.

Graduate Degrees, 2010-11

Sora Kim, October 2010, Ph.D, "Insights into Shark Ecology & Physiology with Stable Isotope Analysis"
Yaofeng He, October 2010, Ph.D, "Wave-equation Migration Velocity Analysis Based on Finite Frequency Sensitivity Kernels"
Reid Parsons, December 2010, Ph.D, "Recent climate change on the Red Planet: Ice (and water?) in unexpected places"
Kathryn Snell, January 2011, Ph.D, "Paleoclimate and Paleoelevation of the Western Cordillera of the United States"
Erin Todd, March 2011, Ph.D, "The youngest rocks from an old arc and the oldest rocks from a juvenile one: The memoirs of a SW Pacific subduction zone"
Nicole Kinsman, March 2011, Ph.D, "Artificial Retention of Beaches in California: Current Extent, Public Opinion & Influence on Backshore Morphology"
Travis O'Brien, May 2011, Ph.D, "The Recent Past and Possible Future Decline of California Coastal Fog"
Calla Schmidt, June 2011, Ph.D, "Managed aquifer recharge to improve groundwater supply and water quality"
Brandon Murphy, May 2011, Ph.D, "Insights from Helium Isotopes into Early Eocene Hyperthermals"
Guangsheng Zhaung, June 2011, Ph.D, "Insights into Cenozoic Tectonics and Climate Change in Northern Tibetan Plateau from Basin Analysis, Thermochronology and Isotope Research"
Jeff Hansen, August 2011, Ph.D, "Ebb-tidal delta and inlet dynamics as a control on adjacent beach morphology"

Rachel Brown, Fall 2010, MS
Scott Rohlf, Winter 2011, MS
Daniel Barandiaran, Spring 2011, MS
Elizabeth Drewes, Spring 2011, MS
Samuel Johnstone, Summer 2011, MS

Graduate Awards

CAMPUS-WIDE OUTSTANDING TA (FACULTY NOMINATED):
Sam Johnstone

DEPARTMENTAL OUTSTANDING TA (STUDENT NOMINATED):
Priya Ganguli (Winner)

HONORABLE MENTION DEPT OUTSTANDING TA:
Megan Avants
David Finn
Lauren Shumaker
Mikael Witte

WATER'S AWARD:
Elizabeth Derse Crook

CHANCELLOR'S DISSERTATION-YEAR FELLOWSHIP AWARD:
Jake Walter

GRADUATE RESEARCH SYMPOSIUM ALUMNI ASSOCIATION AWARD:
Viranga Perera

UCSC DOCTORAL STUDENT SABBATICAL FELLOWSHIP:
David Finn

ARCS AWARD:
Bruce Daniels

LAWSON HYDROLOGY AWARD:
Alanna Lecher
Calla Schmidt

Degrees and Awards: Commencement 2010

Clay Sorenson, Katie Earp, Spencer Estridge, Jackie Liu, and Graham Meese at Mono Lake.

BS/BA

Bai, Anthony Ezra
Bregman, Jonathan David
Brewer, William Andreas
Buffa, Coleman Carter Oakes
Byler, Nicholas W
Carmel, Renee Nicole
Casunuran, Louise-Samantha Basbas
Chase, Annika Capri
Cheney, Derek Childs
Clack, Lauren Heather
David Paul Allen
De Wolk, Antonio Jacques
Earp, Katherine Jane
Estridge, Spencer Joseph
Freitas, Daniel Mark
Gerencher, Lisa Monique
Gilliam, Ashley Elisabeth*
Gray, Harrison James
Howard, Jessica Lynn
Hutchinson, Rebecca Lyn**
Hydeman, Brett Alexander
Johnson, Brittany Danielle
Johnson, Cordell Delann*
Keefauver, Shane Donovan
Larson, Gregory James*
Le, Betty Diemmi
Lindgren, Chelsea Locke
Matal Sol, Ernesto FarabundoMorgan Alexander Michael
Muro, Gabriel Domingo**
Nemerow, Brian Alan
Overton, Sarah Louise
Platel, Arthur Girard
Randall, Tyler Winston
Regalado-Hernandez, Allison Marie
Rice, William Campbell
Rohrbach, Matthew Christopher
Rosenthal, Alex Armstrong
Rushing, Teresa Marie
Saal, Matthew Montgomery B Bovee
Schurmeier, Lauren Rachelle
Sherry, Timothy John
Sipe, Elena May Lani*
Sorensen, Clayton Steven*
Stewart, Devin Thomas
Stewart, Jenna Marie*
Stimson, Matthew Michael
Whitney, Kristen Marie*
Williams, Cameron Howard
Wolf, Evan Michael
Wolfe, Trisha M

* Honors

** Highest Honors

*** Thesis Honors

Undergraduate Awards

Holly Day Barnett Memorial Grant
Kristin Whitney

Association of Women Geologists Outstanding Woman Geoscientist
Rebecca Hutchinson

Weber-Holt Grants
Coleman Buffa
Katherine Earp
Chelsea Lindgren
Jacqueline Liu
Zachery Mayo
Graham Meese
Arthur Platel
Timothy Sherry
Jenna Stewart
David Teimoorian
Chrissy Williams

Ben Moss

Jackie Liu and Katie Earp

Some notes on this year's graduating class

Ben Moss:

My senior capstone was the Summer Field program studying the Poleta Fold Belt in the Owens Valley. It was a blast; we spent about seven hours a day in the field developing a regional geologic setting and geologic history of the field site. During the 5 weeks I learned a lot, the field experience is invaluable. On our off time, in the late afternoons, my favorite pass time was going down to the local convenience store to get a cold drink before heading down to the river for a quick dip to cool off.

The best thing about the Earth Sciences Department at UCSC is the camaraderie between students with their peers as well as with their instructors. The one-on-one instruction I received from all of my teachers was paramount to my academic success. However, instruction only goes so far, and a large part of my academic growth came from my fellow classmates. I spent countless late nights in the D wing with likeminded students discussing difficult concepts and finishing homework sets. Their friendships will last a life time, and hopefully the caffeine addiction will pass.

After completing my summer field work, I've been enjoying my two months of vacation before classes start in the fall. I am returning to UCSC in the fall to finish my minor in Astrophysics. After that is completed I will be applying to grad schools. I would like to go to University of Southern California, to study Paleontology. I would like to dedicate a special thanks to **Hilde Schwartz**; her introductory field class started my love affair with field work. I would not have been able to complete this difficult program without her guidance.

Jackie Liu:

My first earth sci class was 109 Intro to Field Geology with **Jeremy Hourigan**.... he passed out the syllabus and as I read it, i thought, "Where doing what? Where?!" The first field mapping exercise was at Point Lobos. I stood there completely clueless looking at the Carmelo Formation trying desperately to put the contact on my topo map...wait a minute, I didnt even know *where* I was. Weekends later, I trotted around New Idria with field partners **Rachael Klier and Jonathan Kinnear** and other classmates climbing, touching, sweating, falling, measuring, "lost-ing", laughing, and learning. This was my first experience with field work in the department and despite the early confusion, it was one of my favorite memories during my undergrad career.

Now that I have braved the Poleta Folds for my senior capstone, I reflect back on all my field experiences with a fat grin on my face. From stalking lizards with **Katie Earp and Clay Sorenson** to lugging giant carboys of seawater with **Alanna Lecher** will always be good memories for me. In the future, I want to attend grad school for volcanology or something with structural geology. For the next six months, I'm going to surf my brains out in Santa Cruz and learn how to fly airplanes (so I can fly **Tim Sherry's** LiDAR plane one day...haha).

Jerry

Sammy

Grand Canyon Sketch: by Jerry Weber

Alumni GeoArt:

"Pool in North Canyon"

Alumni Notes

1973

Nancy (Benson) Brewster (BS, 1973): I just finished (like 3 weeks ago) my master's in geology, emphasis in vertebrate paleo. I worked on an 80 my old Mosasaur from NW Kansas; had a great time, though it feels pretty good to be done and to have my life back. Still living in Midland, TX. Looking for a teaching job in a community college or university. Found I loved teaching Geology when I was teaching it at Midland College. Hate state budget cuts like all get-out, but understand that they do have to happen sometimes. Hope all goes well at the department. Have 3 kids, one about to graduate from LSU, one about to graduate from OU, and one in Eugene OR working as a webmaster and graphic designer for a magazine. They are all neat people, and I am proud to be their mom. Otherwise, not much going on.

Kevin Biddle (BS, 1973): I am currently the Exploration Director of ExxonMobil International Limited, located in London. I am slowly headed for retirement in Taos New Mexico, but it looks like it will take me a couple of years to get there.

1974

Robert Aston (MS, 1974): I was one of Gary Grigg's grad students. We tried to forge an oceanographer major well before UCSC offered any marine studies. I have gone on to start a company here in Santa Cruz that designs and manufacturers underwater video cameras that are controlled over the Internet. I sell to research, conservation and education organizations around the world.

Alan O. Allwardt (B.S., 1974; M.S., 1979; Ph.D., 1990) received a master's degree from the SJSU School of Library and Information Science in 2003 and now works as an information specialist for the USGS Coastal and Marine Geology Program in Santa Cruz, California.

1975

Richard Gordon (BA, 1975): I'm (still) at Rice University, still doing research in global tectonics including paleomagnetism (mainly marine magnetics), tectonophysics (lithosphere deformation and plate motions), and geodesy. I recently assumed the duties of department chair at Rice (1st time at Rice, but long since I was department chair at Northwestern). I am also in my 2nd year as President-Elect of the Geomagnetism and Paleomagnetism section of AGU. Unfortunately the latter means that I will be missing the UCSC Thirsty Bear event at AGU for the next few years as it seems always to be scheduled the same evening as the GP business meeting. It's too bad as I have really enjoyed seeing UCSC faculty members and fellow alums when I've been able to attend. Maybe I can meet up with some of you another evening of AGU. In the non-work, non-science category, I took up the trumpet a few years ago after not having played a brass instrument since high school, and have been playing in a couple of Rice jazz bands (a big band and a smaller lab band) and in the Houston Concert Band (a community band).

1976

Richard Fink, (BS, 1976): After leaving UCSC, I joined Conservation Div. of the USGS in Anchorage for a year helping interpret and plot off shore oil lease sale geophysical data for Lower Cook Inlet. It was fun because I was able to assist with high resolution sparker, side scan sonar, etc. for assessing geohazards for pipelines or oil rigs. After a year though, I went back to get my Masters in Geology at Mackey School of Mines at the University of Nevada Reno where I worked with Bert Slemmons on faulting in the Owens Valley. After graduating, I have worked the past 34 years in the geotechnical/environmental (hazardous) industry, the first 7 years till 1986 with SEA Engineers in Reno doing geotech work then from then till present with Kleinfelder, Inc., primarily doing environmental assessment work and site remediation projects. I have been in the Fresno office of Kleinfelder since 1990. I am also the current chair of the San Joaquin Valley chapter of the Sacramento Section of AEG.

1977

Tom Bertucci, (BS, 1977): Although I thoroughly enjoyed my time at Santa Cruz and have a continuing interest in our planet, my career took a turn to engineering when I moved to Seattle in 1978 soon after graduating. I am a bridge engineer with the Washington State Dept. of Transportation, Ferries Division. As a result my main earth science-related interests are foundations and the seismic design of marine structures. However, I still enjoying exploring the mountains and waters up here and reading about the latest advances in earth science. In fact I am currently reading John McPhee's *Assembling California*, in which, just two days ago I came across your name(!), when he mentions your research on ophiolites in Indonesia. And just a few months ago, I discovered that a colleague in WSDOT's Geotechnical Branch with whom I work closely is Pete Palmerson, who also graduated from the department, a number of years after I did.

Larry Smith, (BS, 1977): My relatively new information is that I changed jobs here at Montana Tech of the University of Montana, and started teaching in the Department of Geological Engineering in 2009. I had been a research geologist at the Montana Bureau of Mines and Geology (the state geologic survey – a department of Montana Tech) for 16 years. So, after doing Quaternary geology, regional stratigraphy, and surface and subsurface mapping as part of a state-wide groundwater mapping program, I began a teaching career in my mid-50s. I bill myself as the oldest Assistant Professor on campus. I'm the soft-rock person in a five-member department, parlaying my graduate work at the University of New Mexico and my five years as an exploration geologist for Shell in Houston, in teaching our undergrads, a few M.S. students, and a lot of Petroleum Engineering students why geology is important. I still remember the great teaching by Casey Moore, Jim Gill, Ken Cameron, yourself, and Bob Garrison, and try to be as energetic as they were then. I also remember the great teaching by grad and undergrad students at UCSC, especially Betsy Beyer (now Beaumont?), Parke Snavely, Penny (now Bowen), and Allison Till (leading by example).

Frank Perry, (BA, 1977): I continue to work for various nonprofit organizations involved with the natural sciences and cultural history of the central California coastal region. I have also been collaborating with other scientists in an effort to share research I did many years ago on the Neogene Purisima Formation, including co-authoring an article in 2011 for the journal *Palaios* about fossil bite marks on fur seal bones. I serve as president of the Friends of the Cowell Lime Works Historic District, which is restoring some of the historic buildings and lime kilns on the UCSC campus (http://limeworks.ucsc.edu).

Fraser Goff (PhD, 1977): Fraser worked 26 years on geothermal, volcanology, environmental, and drilling projects at Los Alamos National Laboratory, New Mexico and retired in 2004. Fraser became Fellow of the Geological Society of America (1990) and Adjunct Professor in the Earth and Space Sciences Dept, University of New Mexico (1992). He now provides contract geologic maps for the New Mexico Bureau of Geology and Mineral Resources and operates a small geologic consulting business. Fraser recently published a book on *Valles Caldera - A Geologic History* (UNM Press, 114 p., 2009). He and wife Cathy have 4 children and 4 grandchildren. They alternately reside in Kailua-Kona, Hawaii and Los Alamos, New Mexico.

Greg McNair (BA, 1977): Happily married retired 60 year old VW guru & slum lord that loves racing VWs & lives in Salinas.

Jon Spencer (BS, 1977): It has been 35 years since I took your (and Casey Moore's) circum-Pacific tectonics seminar. That was one of the academic highlights of my time as an undergraduate, and the time when I began to develop a passion for extensional tectonics, a passion that continues to this day. After receiving a Ph.D. in geology from MIT in 1981, and doing a one year post-doc at the USGS in Menlo Park, I have spent the past 29 years working for the Arizona Geological Survey, where I am now Senior Geologist. For most of my time I work on the STATEMAP program, which is a component of the National Geologic Mapping Act of 1992. Through this program, the Arizona Geological Survey has received over $3 million over the past 18 years, all of it used for geologic mapping. I have had the good fortune of being able to do geologic mapping every year now for the past 32 years, as well as participate in related studies of the structure, tectonics, and ore deposits of the Mojave-Sonora Desert region of southern and western Arizona (I don't do field work in the summer – way too hot!). My wife and I live in Tucson, and have two grown children, one of whom went to UCSC for two years.

Lisa Wright (BS, 1977): I have spent the last 13 years working for ConocoPhillips as a development geologist for reservoirs on Alaska's North Slope. I spent several years working on various aspects of the giant Kuparuk oil field, which has produced more than 2.2 billion barrels of oil from more than 1100 wells. These lower shoreface and shallow marine sands form stratigraphically separated reservoirs that are frequently juxtaposed by significant faulting (over 7,000 individually mapped faults). I have prospected and drilled development and field delineation wells, in addition to studying biodegradation and oil geochemistry. About 3 years ago I became the development geologist for the Tarn and Meltwater fields, which are smaller satellite fields of Kuparuk. These are slope turbidite reservoirs with unusual mineralogy and thinly bed pay. My team is now using horizontal wells with multi-stage fracs to access distal reservoir sands with permeabilities of 0.5-1 mD. This is not really a resource play, but it's not a typical North Slope development, either. Working Alaska has given me a fascinating career, with rapidly developing technology opening new challenges all the time, plus I've gotten to live, raise a family, and play in a truly wonderful place.

1978

Ken Johnson (BS, 1978): I am currently working at the engineering design firm Parsons Brinckerhoff in San Francisco and am the Geotechnical Discipline Lead for the final design and construction for the Central Subway project here in San Francisco. The project is being built by the SF Municipal Transportation Agency, and constitutes Phase 2 of the Third Street Light Rail Project. How did I get here from UCSC? When I finished up in December 1978 I worked for Gerry Weber for a short time before being hired at the USGS (Marine Geology Division) in July 1979 where I worked for 2+ years in the Gulf of Alaska and Bering Sea. Following that I spent 5 years earning a MS and PhD in Civil Engineering and Geological Engineering at UC Berkeley. Upon graduation in 1987 I began

working for an engineering and geological consulting company called Geomatrix in San Francisco for 11 years, moving then to another consulting firm called MFG, Inc. for 6 years. At this point I was offered a Lecturer Position at UCB where for 5 years I taught ”Introduction to Engineering Geology” to civil engineering undergrads , impressing upon them the critical importance of accounting for all things geological in any engineering project. After engaging classes of 60-80 students through this period I was offered the opportunity to work on the Central Subway, and that is where I am today.

Steve Rowland (PhD, 1978): Greetings from the margin of the Paleozoic craton. I've been on the faculty at the University of Nevada, Las Vegas since graduating from UCSC. My research has drifted from the paleontology of Cambrian reefs into studies of Jurassic trackways and Pleistocene mammals. Also, inspired by Leo's work in the history of geology, I have just completed the translation of a book by eighteenth-century Russian scholar MIkhail Lomonosov, to be published as a GSA Special Paper.

1979

Genevieve Fire (BS, 1979): After graduating from UCSC, Genevieve went on to earn an M.S. in Civil Engineering from UC Davis and is a California registered Professional Civil Engineer. She has worked extensively for municipalities in Northern California and is currently employed by the City of Mountain View Public Works Department. In addition, as the owner of her own company, she consults with other local public agencies, specializing in storm water quality management. She lives in Los Altos and is married with two children (one studying civil engineering at UCB and the other a junior in high school). When not working or kid-wrangling, she enjoys bicycling (yes, still, after 40 years), playing viola in two amateur string quartets, gardening, and traveling.

Ronny Miyaoka, (BS, 1979): Now in my 21st year teaching math and science after having spent 13 years working as a geologist with the U.S. Geological Survey, Branch of Alaskan Geology. Currently I’m teaching geology, astronomy, and earth science at Robert Service High School in Anchorage. Son, Neil, junior at Boise State (engineering), daughter, Jessica, just graduated college and is working in the DNA section at the Alaska State Crime Lab.

Bruce Lymburn, (BA, 1979): I’m chief legal counsel for Clif Bar & Company, the energy bar and organic foods company. I’ve held this job for seven years. Not exactly a career in earth sciences, but no doubt that my UCSC education helped develop my analytical thinking and an appreciation for global environmental issues.

1980

Laurie Green (nee Brown - and yes, I do get the humor of that**, MS, 1980):** So far (30 years and counting), it's been an endlessly interesting career. I have worked in the US and internationally for a major, an independent and several consulting companies on oil exploration and development projects. For the past 6 years I have been with Hess, first as a geoscientist modeling deepwater Gulf of Mexico fields and more recently as a technology and planning manager. Some of the highlights have been technical work on Kuwait's reparation claims after the first Gulf War, expatriate stints in Russia and Malaysia, and lots of time in South America where the geology is fascinating, the people are great and the food and wine are terrific. The lowlight of course was the

bust of the mid-80's, when work was scarce and my family was growing. Even that turned out well, though, as it forced me out of a predictable path with a major and led to a varied and fulfilling career. One marriage, two kids and several dogs later, the oil patch is still where I want to be. I knew from age 12 that I would be a geologist, and you and UCSC helped tremendously to make that happen. Thanks from a grateful slug!

Gerald Weber (PhD, 1980): So far this fall I've been mostly getting body parts replaced...lens in right eye, new right knee. Despite this I'm continuing to work as a consultant, giving occasional lectures to classes at UCSC and working on coastal erosion stuff. Still running raft trips in the late summer on the Green and trying to spend time in Africa. Taking art classes and spend a fair amount of time drawing. An example is attached - Pool in North Canyon. If you get to SC give me a call and let's grab a beer.

Judith Fierstein (BS, 1980; MS, 1989): I'm still a geologist with the USGS Volcano Science Center in Menlo Park (it's been 31 years!). I have been mapping volcanic fields in Alaska, Washington, Oregon, California, and Chile, with the aim of detailing their eruptive histories in a well-constrained time-stratigraphic context. Current projects include Three Sisters volcanoes in Oregon, the Simcoe Mountain volcanic field in Washington, and Mammoth Mountain and vicinity in California. Another focus of mine are explosive eruptions and their tephra deposits, including emplacement and eruption dynamics. Current projects include the 1912 eruption of Novarupta and the Valley of Ten Thousand Smokes, AK; Newberry caldera in Oregon, and post-glacial silicic tephra (deposited in Argentina) from Laguna del Maule volcanic field (located in Chile). Keeps me busy and in the field a lot---I love it!

1981

Richard Gunderson (BS, 1981; MS, 1983): I've been working in the geothermal business since finishing my MS in 1983. I worked for Unocal for 22 years until Chevron bought us out in 2005. I then consulted for a few years, but just recently rejoined Chevron since most of my consulting work was for them anyway. I'm currently living in Jakarta, Indonesia with my wife and son. One of my daughters is at UCLA and the other finished with college a couple of years ago, so they are both living on their own in California still (sorry, no additional slugs in the family so far). Over the years I've worked in the western US, Mexico, Central America, South America, Alaska, the Philippines, Indonesia, New Zealand, Kenya, and Turkey, so there has been a little travel involved! I've worked with fellow geo-slugs Gregg Nordquist, Mitch Stark, and Mark Mosby for many years at Unocal/Chevron, and I have crossed paths with a few others in the geothermal industry (Bob Creede, Will Osborne, Bob Daniel to name a few). Gregg, Mark, Mitch, and I have had a hand in discovering and developing some of the largest geothermal fields in the world...primarily here in Indonesia, but also in the Philippines and California. And we're all still beavering away, at least for a few more years, looking for more. I hope that all is well in the ES department. I came to town for an ES reunion a few years ago...went on a field trip up the coast with Gerry, threw the softball with Alan Allwardt, and visited some with Dan Sampson and others from the late 70'-early 80's. It was a nice reunion, and I hope I can come back again for another one when I'm back in northern California in the spring.

1982

Chris Obert, BA, (1982): Chris is still into oil, he just has it under his fingernails! Chris's hobby of repairing Fiat automobiles has turned him into a local Santa Cruz businessman. He started a company that ended up being the largest Fiat parts distributor in North America. He now splits his time between working in the mail order business www.fiatplus.com and in his shop restoring Fiats for clients from all over the world. He spends

his spare time racing automobiles, doing car & business related stuff, and enjoying his garden. His two kids are now off in college.

1983

Cathryn Newton (PhD, 1983): I completed an eight-year term as Dean of the College of Arts and Sciences (Syracuse University), in which we created tremendous new facilities for both the Natural Sciences (including a 230,000 sq ft Life Sciences Complex) and the Humanities (a gorgeous restoration of an Archimedes Russell building that had originally been built to house the papers of eminent historian Leopold von Ranke). On research leave, I began a serious book project that will be complete early in 2012.

Patrick Hogan (BS, 1983): I've been with NASA for the past twenty years. Came onboard as hydrogeologist (RG) to defend Ames Research Center against implication in the Mountain View, Middlefield-Ellis-Whisman (MEW) Superfund plume (TCE). Though I hung up my guns on that one some years ago and took on management of NASA Learning Technologies (working on ways to get NASA content into the classroom which led to the pleasure of getting to know Ed Landesman, former Math 'Chair' at UCSC.). As a result, for the past nine years have been managing the World Wind project, infrastructure for spatial data, software technology that provides fully navigable 3D access to global data (just like Google Earth only open source). You can see it here, http://worldwind.arc.nasa.gov/, though this site does a better job, http://goworldwind.org/.

Jeff Cauhape (BA, 1983): Well, it's been an interesting 29 years... I'll just summarize it by saying that after discovering my talent was in software, life became more pleasant. I worked for IBM, and am a Staff Software Engineer in the Information Management Division. I work from home doing advanced support for our connectivity tools. Home is a tree shaded acre of land in the Eastern foothills of the Carson Valley, just East of Lake Tahoe. My wife, daughter, and I moved here in January from Truckee, CA, and since then have added chickens, fruit trees, and a raised bed garden to the place. We hope to have a corral in place by the end of September. We have found this area to be amazingly friendly, and feel more connected to the local community already than we have at any other place we have lived.

Victoria Pease (BS, 1983): Some 30 years on (eek!) from my UCSC undergrad degree, I am Prof. of Tectonics & Magmatism at the Dept of Geological Sciences, Stockholm University, Sweden. My research today builds on what I learned as an undergrad at UCSC and the skills I developed beginning with my undergrad thesis project. I currently have 2 principal projects on the tectonic evolution of the Red Sea region and Circum-Arctic Lithosphere Evolution.

1984

Michael Ort, (BS, 1984): I am still a professor at Northern Arizona University, and study volcanoes using field work, paleomagnetism, and geochemistry. Current projects are in Ecuador, Bolivia, Mexico, Italy, Arizona, and the eastern Aleutians. In the eastern Aleutians, I am working with another Slug, Jessica Faust Larsen. Still married to Nancy Riggs, another geology prof at NAU. We have one daughter in high school.

G. Leigh Lyons, (BA, 1984): I spent most of my career in the oil and natural gas business, and most of

that working and living in South America (where I grew up). I moved back to the U.S. after five years in Bolivia in 2005 and started a consulting business, helping high risk investors start companies, primarily in the energy sector. When things went south with the economy, so did my business. I started writing. Much to my surprise, I finished several books, landed a legendary agent in New York, and sold my first book to the same publisher in London that brought us the Harry Potter series (same editor in fact). I now write full-time - adventure stories for younger readers. "Avery McShane and the Silver Spurs' will hit the bookshelves the first week of January. My website: www.gleighlyons.com. I (sort of) maintain several blogs about my writing experience, about growing up as a Third Culture Kid, and even one about my Avery McShane character.

1985

George L. Williams (BS, 1985): From 1985-1998 I provided geo-environmental consulting (groundwater & soil remediation services) for firms in San Jose and Los Angeles, and later provided corporate environmental affairs services at Boeing during that timeframe. I decided to get out of the Hazardous Waste business though and get into the cleaner less hazardous Information Technology workplace in 1999. I have been caught in the unemployment bust for the last few years. I was working as a contract IT Project Manager with Boeing's Shared Services Group (SSG) in Seattle when I was laid off in January 2009. I have been essentially unemployed since then. I offer my services as a self-employed contractor in Geographic Information Systems (GIS), Database & Business Intelligence Services, and Business Process Improvement (ISO 9000, CQI, and other quality improvement processes - www.facebook.com/AppliedGeo).

Gail Bakker (BS, 1985): After graduating from UCSC, I worked for the Santa Clara Valley Water District for a few years, then got a Masters Degree in Water Resources Engineering from Stanford. After that, I got married, moved to Grass Valley, California and worked for several environmental consulting firms doing hydrogeology for over twenty years. I still live in Grass Valley with my husband, Bob Husk, and two cats. I now work for the Forest Service as a hydrologist (the Forest Service doesn't really know what a hydrogeologist is). I evaluate the impacts of proposed Forest Service projects on local hydrology and do the odd CERCLA landfill or mine site on occasion. I love that all of my projects are in the forest and not on active or abandoned industrial sites.

1986

Jonathan Schmuck, (BS, 1986): Johnathon was awarded the first Fulbright Scholarship to attend the Canberra School of Art, in Australia, where he completed his postgraduate studies Glassmaking, and received a Master of Visual Arts (MVA) degree in 2000. Johnathon was fortunate enough to work with Klaus Moje while the Roll Up technique for blowing kiln-formed glass was being perfected in the Glass Workshop at Canberra. Johnathon also had chance to learn coldworking with maestro Stephen Procter, and he has subsequently written The Joy of Cold-working, a book about grinding, smoothing, and polishing blown and fused glass. Johnathon has a studio on the westside of Santa Cruz, and he runs the kiln-forming program at the Bay Area Glass Institute (www.bagi.org) in San Jose. He has taught glassmaking at Corning, Espace Verre in Montreal, Oatka Glass School, Escuela del Vidrio in la Granja, Spain, Pittsburgh Glass Center, Wired Designs in San Antonio, Texas, and throughout the United States. His website is www.schmuckglass.com

Curtis Payton (BS, 1986): Working as a technical lead and geologist for the U.S. Army Corps of Engineers. Deploying for a 2 week Dam assessment tour in Afghanistan in September that will involve inventory of six dams for current engineering geology conditions, geologic hazards, earth materials used for construction, potential design flaws with respect to geologic conditions, and potential borrow sources. Just completed a 90-day assignment as Acting Chief of the Geology Section for the Sacramento District. Currently technical lead for hazardous/ toxic, waste issues for the Napa River / Napa Creek levee improvement and flood protection projects. Also team lead for Sacramento District waste soil characterization for hazardous/toxic potential contaminants of concern during levee repair and/or reconstruction. Continue to make an annual trek to Santa Cruz to enjoy the Shakespeare festival.

1987

Lisa Dierauf (BS, 1987) is working as the Community Outreach Coordinator for the City of Boulder's Open Space and Mountain Parks Department. She has been with the city for 17 years. OSMP.org

Larry O'Hanlon (BS, 1987) has recently taken on the job of Communications & Public Programs Offficer for the W.M. Keck Observatory on Mauna Kea, in Hawaii. That's after 12 years as a freelance science writer, primarily on contract handling Earth science content for Discovery News.

Mark Reagan (PhD, 1987): I am now the Department Executive Officer (Chair) of the Department of Geoscience at the University of Iowa.

Ken Manatt (BS, 1987) is alive and well. I have traveled a little to Croatia, Madagascar, Kazakstan. I am employed enough to pay the bills.

1988

Dave Longstreth, (BS, 1988): I took an enjoyable introductory course of yours in 1988 about plate tectonics. I researched and wrote an essay about the planet Mars and how the lack of water makes the planet tectonically dead. Perhaps I was wrong about the water? I graduated that year and went to graduate school at SUNY Stony Brook where I left after a year (no mountains). I worked in Southern California as an engineering geologist for about 11 years before returning to Northern California (Mendocino County) where I work for the State of California as an Engineering Geologist. I work for the California Geological Survey but am contracted out to Cal Fire where I evaluate the potential for post fire debris sliding and other emergencies of geologic nature. My son will be a freshman this fall at College Eight. Further proof that the apple doesn't fall from the tree. He is excited and so am I, but will miss having him around.

Jim Sample, (PhD, 1988): I'm a full professor at Northern Arizona University. Mary and I have been here about ten years. Recently our department merged with environmental to form the School of Earth Sciences and Environmental Sustainability (quite a mouthful!). We are starting a new PhD program in the school and will be looking for some good students to start next fall, so pass the word. I love teaching geology at NAU. We have a

few rocks around, although most of my work is closer to or in the ocean realm. We are doing okay in the budget climate. We have 150 undergrad majors and 35 masters students, so we can fly under the radar somewhat.

1989

Kathy Campbell (BS, 1989) is a paleontology professor at the University of Auckland, New Zealand. Current research projects include life in extreme (paleo)environments – marine hydrocarbon seeps (Hikurangi, Cascadia and Chilean margins) and terrestrial hot springs (Quaternary Taupo Volcanic Zone and Jurassic of Argentinean Patagonia) – and trace fossils as high resolution paleoenvironmental indicators. Kathy recently received the Hochstetter Lecturer award by the Geosciences Society of New Zealand.

1991

Fred Hochstaedter, (PhD, 1991): I am a full-time Earth Science teacher at Monterey Peninsula College. I've been here since 1998. I've hired a few UCSC grad students and post-docs as adjunct teachers down here as we occasionally have the need for adjunct instructors. I currently working on a project to create time animations of oceanographic properties to improve Oceanography instruction.

Dan Orange (PhD, 1991): DanO and his wife Bonnie and their 3 kids have now been in Jakarta, Indonesia for 5 years. They moved there to join fellow alum Phil Teas (PhD, 1998) and 6 of Phil's ex-Unocal coworkers in forming a start-up oil and gas exploration company, Black Gold Energy. Black Gold applied the seep science that Dan and Phil first learned under Casey Moore to 400,000 km^2 of Indonesia's unmapped offshore basins. Using high-resolution multibeam mapping, and USBL-navigated piston cores, Black Gold obtained valuable information on the distribution and quality of the petroleum system in 10 large survey areas. Niko Resources Ltd., a publicly traded independent Canadian exploration and production company, bought Black Gold in Dec. '09. Niko has been acquiring 2D and 3D seismic data over 18 Production Sharing Contract (PSC) blocks that Black Gold, and now Niko, have picked up, and will begin an extensive multi-year deep water drilling program in mid-2012 to interrogate the portfolio. DanO is now Niko's VP of Voodoo Technology (his real title), which basically means that anything that's not seismic, and not drilling, ends up on his desk. Niko is in the middle of their 2nd Indonesia Mega-Survey (250,000 km^2), and is in the planning stages for a 3rd mega-survey in a different part of the world.

Barrie Taylor (PhD, 1991): I'm still at Landmark Graphics, working on Research and Development and testing geophysical imaging software.

Conrad Seales (BS, 1991): CPA and partner in the firm Meisser & Seales, LLP of Santa Cruz California.

1992

Rick Behl, (PhD, 1992): Times are both good and bad here at CSU Long Beach. The budget is horrible - we don't have money for paper to put in our copying machine and we are barely holding on to our long-term, full -time lecturers. But, our program continues to grow in enrollment (65 undergrads, 56 MS students) and we just moved into a brand new building with very nice (but smaller) space. After 15 years of focusing on Quaternary sedimentology / paleoceanography, I'm returning my focus to the Monterey Formation and started CSULB's first

industrial affiliates program. I call it the MARS Project (Monterey and Related Sediments) and have 8 corporate members and am supporting 8 or my 10 grad students. However, I still work on the younger stuff in the Santa Barbara Channel and am on the steering committee of the PAGES Varves Working Group. Last year, I was honored by being named the 2010 Distinguished Educator of the AAPG-Pacific Section. Cool! I just sent one of the undergrads in my lab to Boulder to start her PhD where she met Lon Abbott and Bob Anderson! Another of my MS students just finished her PhD at UCLA and another (currently teaching high school) was presented with a MIT Inspirational Teacher award. So good teachers like you, Casey, and Bob Garrison are still propagating your inspirational teaching.

Richard Koehler, (BA, 1992): After completing a PhD at University of Nevada Reno in 2009 I have been employed as an earthquake geologist with the State of Alaska, Division of Geological and Geophysical Surveys. I am compiling the Alaska fault and fold database for the USGS, collaborating on several NSF research grants aimed at understanding recurrence of subduction zone earthquakes, and in charge of geologic hazards studies for proposed natural gas pipelines.

1993

John Bonsangue, (BS, 1993): Principal Hydrogeologist – Orange County Water District, Orange County, CA. I manage an artificial recharge program that injects recycled water into the coastal aquifer system to control the landward migration of seawater into the groundwater basin, which provides 2/3 of the water supply for the county.

1994

Julie Blue (MS, 1994): I am working at The Cadmus Group, Inc., a small environmental consulting and engineering firm based in Watertown, MA (though I work from my home in Amherst, MA). Cadmus is primarily an EPA contractor. I spend most of my time leading our Environmental Research Practice, which includes research for EPA's Office of Research and Development, for the U.S. Army Corps of Engineers, and for organizations such as the Water Research Foundation. My focus for the past few years has been on assessing the vulnerability of drinking water, water resources in general, and aquatic ecosystems to climate change. This past week, our report on "Aquatic Ecosystems, Water Quality, and Global Change: Challenges of Conducting Multi-Stressor Vulnerability Assessments" has been published (http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=231508). The rest of my time I spend with my 4-year old son, Snowden, working on the Community-Supported Agriculture (CSA) farm to which we belong, taking music classes together, and eating maple candy.

Todd Greene, (BS, 1994): I am in my 4th year as an Assistant Professor at CSU-Chico in the Department of Geological and Environmental Sciences. I happily remain in the UCSC-EPS family by being married almost 10 years to fellow graduate (1990) Jeanne Buckthal (now Greene) and being father to our almost 8 year old daughter, Callie (the most knowledgeable geologist in her grade).

1995

Kirsten Menking (PhD, 1995): I'm presently chair of the Dept. of Earth Science and Geography at Vassar College and an associate professor of Earth Science. I also teach with some frequency in the Environmental Studies program. I'm involved in research projects into the climate history of central New Mexico and southeast-

ern New York through various proxies found in lake sediments. I'm also becoming a mom to a 12-yr-old boy I'll be adopting later this year.

1996

Jorine Campopiano (formerly Lawyer, BS, 1996): I am currently working at the US Environmental Protection Agency in Los Angeles. I am working as a Schools Children's Health Coordinator. Still get to use my earth science background for groundwater and contamination issues!

Justin Cameron Carella (BS, 1996): Despite studying Earth Sciences, I work now in International asset management marketing and live in Copenhagen, Denmark. It's a big difference from Earth Science.

1997

Glen Wallace, (MS, 1997): I am currently working as a consulting geologist with Pacific Groundwater Group in Seattle, Washington. I completed my PhD at the University of Washington in 2004.

Erika Wise (B.S. 1997) is an assistant professor of geography at the University of North Carolina at Chapel Hill.

Joel Podgorski (BS, 1997) is doing a PhD project at ETH Zurich using geophysics to study the hydrogeology of the Okavango Delta, Botswana.

1998

Amy Ewing, P.G. (BS, 1998) works as a hydrogeologist at Daniel B. Stephens & Associates, Inc. in Albuquerque, specializing in water supply and conservation planning, watershed management, and water resources investigation projects.

Katharina Billups (PhD, 1998): I am currently an Associate Professor at the University of Delaware. I am also the Associate Program Director for our Oceanography Program. Here is a link to my website: http://www.ceoe.udel.edu/people/profile.aspx?kbillups

1999

Phil Stauffer, (PhD, 1999): I am now a Scientist IV at Los Alamos, running a few projects including Carbon Sequestration and Nuclear Waste Management. My CV with some good recent pubs is on the UC server, es.ucsc.edu/~phlip/cv.html. One of my big new projects is the CERC US-China Clean Coal Research Center. We collaborated with LLNL WVU UW and UKY to get 25$M DOE for collaboration with China on clean coal tech.

Justin Meek, (BS, 1999): After graduating from UCSC with a BS in Earth Sciences and BA in Environmental Studies, Justin Meek worked as an environmental planner for over seven years for a private planning and civil engineering firm. In the wake of the "great recession" he returned to school at San José State University (SJSU) to receive a master of urban planning (2010) and currently teaches a course on community assessment to graduate planning students at SJSU. On days Justin is not teaching, he provides planning consulting services to local municipalities, such as the cities of Pacific Grove and Marina. In addition to his professional work, Justin serves as the Administrative Director for the American Planning Association California Chapter, Northern Section, and sits of the Alumni Board of SJSU's Urban and Regional Planning Department.

Peter Weiler (PhD, 1999): Peter Weiler is living in Berkeley with his spouse and just-turned-five-year-old son. He has wound up merging his academic career with his previous consulting career by performing shallow geophysical surveys (mostly resistivity, time- and frequency-domain electromegnetics, self-potential and magnetic surveys) for environmental and water-resources projects. He is on Facebook.

2000

Josh Stein, (PhD, 2000): A bit more than two years ago I switched fields and left a dying Yucca Mountain project (after submitting a license application to the NRC) and started doing research in photovoltaics energy systems. I now lead the Photovoltaic Systems Modeling and Analysis team at Sandia National Laboratories. We develop, validate, and use numerical models of photovoltaic system performance to evaluate the economics and technical integration issues involved with connecting PV systems to the electrical grid. Much of my research has focused on characterizing, forecasting, and predicting the effects of clouds (specifically cloud shadows)on PV plant output variability. On a personal side, Emily and I have two great kids (Megan, 9, and Matthew, 7). Emily just completed a 500 hour Yoga teacher training and is preparing to teach prenatal yoga this fall.

Stefano Mazzoni, (MS, 2000): I am working as a geological advisor in the California Exploration Team for Occidental Oil & Gas in Bakersfield, finding and developing new oil & gas resources in our great state. Organize geoscience field trips for Oxy geoscientists and engineers. Serving as Vice-President of the San Joaquin Geological Society and the Field Trip Coordinator for the 2012 National AAPG Convention in Long Beach next April. Also serving as an Alternate Delegate for the Pacific Region for the Association for Women Geoscientists. Spending lots of time in Mammoth, and traveling around other parts of California.

Janet Yun, (PhD, 2000): I'm still here at Chevron, baking away in this record Texas heat! It's been a couple of years since I was last on campus recruiting; I'm hopeful that I might be able to swing a trip this fall, maybe in October. Things continue to be busy here. I'm working in the Atlantic Canada Exploration team now (still based in Houston, though), doing regional mapping and prospect identification. The area I work has a complex rifting history, which makes for interesting and challenging work. Still doing recruiting for the company, although this year I had to scale back my role due to schedule conflicts.

Murray Eiland (MS, 2000): I have many fond memories, and particular greetings to Professor Williams. I am Managing Editor of the London based Minerva Magazine.

2001

Nicole Beck, (PhD, 2001): I am the owner and principal of the firm 2NDNATURE. You can download our SOQ from http://www.2ndnaturellc.com/qualifications.htm

Matthew Huber, (PhD, 2001): I am now a full professor at Purdue University, still working on Eocene paleoclimate models and other things as well. I just got funded with Joe Galewsky to work on the history of the Sierras from a modeling perspective as well. So the work that started at UCSC continues! Anne and I have two kids, Lily and Daniel, a new dog Pele, and the same cat we had in grad school, Marquis.

Patrick Testoni, (BS, 2001): I work here at UC Santa Cruz (since 2001), as Energy Manager. I currently lead, develop, and manage energy efficiency projects, solar photovoltaic projects, and greenhouse gas inventory

management. I am working on lowering the campus carbon footprint through lighting and building ventilation upgrades, as well as cleaning up the campus' sources of fossil fuels. There is also multiple solar projects in development, including a photovoltaic array on the McHenry Library roof and a solar thermal heating array at OPERS and Long Marine Lab dolphin pool.

Brian Lockwood (BS, 2001; MS, 2004) works for the Pajaro Valley Water Management Agency, located in Watsonville, CA, in the role of Staff Hydrologist. Incidentally, the Agency's General Manger, Mary Bannister, is also a UCSC Earth Sci alum.

2002

Kelly Macgregor (PhD, 2002) is an Associate Professor at Macalester College (St. Paul, MN) in the Geology Department. Justin (Revenaugh) is still a professor at the University of Minnesota in the Geology and Geophysics Department. We miss you all in Santa Cruz!!! Our kids are growing up - Emma is 9 and Silas is 6. We've both been doing field work - Justin has been installing seismometers all over MN and up across the Canadian Shield, and I've been working in Glacier National Park, MT, British Columbia, and along the St, Croix River (MN/WI). Justin ends up in the media talking about natural disasters quite a bit - as the only seismologist at the U he tends to field all the questions related to tsunamis, earthquakes, etc. We've been doing quite a bit more cross country skiing, ice skating, hockey and sledding here than in Santa Cruz, but miss the sea lion noise!

Brigette Martini (PhD, 2002): After spending several years in the Defense industry in Ohio, Brigette is currently the Sr. Staff Geologist in the Exploration group at Ormat Technologies, Inc., a geothermal energy company based in Reno, NV. Along with abundant field work in Alaska, Hawai'i, Oregon and Nevada, Brigette, her husband Chris and their two dogs enjoy making the most of Tahoe and the Nevada outback out their front door.

Cara Clark (BS, 2002): Cara Clark is a Senior Wetland Scientist with the Central Coast Wetlands Group at Moss Landing Marine Labs. She received an M.S. in Coastal and Watershed Science and Policy from CSU Monterey Bay in 2008. She is on a statewide team that develops, implements and trains people in the California Rapid Assessment Method (CRAM). She will be focusing on developing CRAM modules for coastal bar-built estuaries (lagoons) and wet meadows over the next year. She also works on wetland restoration and monitoring in the Monterey Bay area.

John Cook (MS, 2002): I am still in Santa Cruz County and still teaching intro and CA geology classes over the hill at West Valley, DeAnza and Skyline Colleges. I began teaching at West Valley right after graduation which led to making connections and teaching at the other schools. I owe everything to the connections I made at UCSC – Hilde Schwartz recommending me to Robert Lopez as a field camp TA the summer after graduation started the ball rolling. I have developed and take my West Valley Class on 5 field trips during lab periods. I developed an equal number of field trips for my Skyline Classes - sites stretching from Mussel Rock to Pillar Point along the coast and the rift from San Andreas Lake to Crystal Springs Reservoir - before the program was cut a year ago. I have a night class there this semester but it looks like this might be the end. My wife and I have taken up running half marathons over the last three years. We've done the Big Sur, Santa Cruz and Salinas half marathons twice so far. We also swim and bike on a regular basis. I am currently learning to ride the unicycle and making decent progress. I have aspirations of trail riding once I reach a sufficient level of proficiency. We hiked and ran the trail to Half Dome last summer from Curry Village in 9 hours (compared to our previous non-running times of 12-13 hours). It was over 100 on the valley floor and 85 at the summit. We took a road trip to Craters of

the Moon, Glacier National Park and Yellowstone over the summer. We both still love CA and our little house just a few minutes' walk from the beach.

2003

Lisé Whitfield, (MS, 2003): I graduated UCSC with my M.S. (working with Elise and Quentin) in 2003, taught earth and physical science for 5 years in San Jose and Santa Cruz, and then returned to school again to get my master's in Science Education. I am currently a Research Scientist at the University of Washington in the College of Education doing research on project-based learning in advanced earth and environmental science courses. We're testing the experimental project-based earth and environmental science curriculum with 1800 students in 4 states. It's been exciting! I have such great memories of my time at UCSC and keep in touch with many of my colleagues from that time.

Chris Pluhar (PhD, 2003): I'm in my 5th year as assistant professor at Calstate Fresno, married to Kellie Townsend, former dept staff member.

Debbie Prinkey (MS, 2003): I'm now teaching regular and AP physics at Mount Vernon High School (my alma mater) in Mt. Vernon, Ohio. No other updates to report... no kids... not married, etc!

2004

Carrie Ryder Evje (MS, 2004): I got certified to teach junior high and high school in Norway this past spring (where I've been living since 2004). I am now working at a local junior high school where I teach math, science, English, and German. All of the classes are taught in Norwegian except for English which is mostly taught in English. I learned Norwegian once I moved over here. I hope to be able to teach more science classes in the future - I have to just wait and see if someone retires :)

2005

Ben Melosh, (BS, 2005): I graduated in 2005 and am currently pursuing a PhD in geological sciences at McGill university in Montreal Canada and developing a passion for white rafting instilled by one Gerald Weber.

Greg Spear, (BS, 2005): After getting my B.S. in Earth Science/Planetary Science in 2005, I entered the M.A./Credential program to become a teacher. It was probably the most difficult year of my entire life... Since graduating, I became an Earth Science teacher at Harbor High School in Santa Cruz and am still there. I've also taught Conceptual Physics (physics for "non-science" type students read: art/athletes/English/History types) and am, this year, a teacher at ARK Independent Studies at Branciforte Small School Campus. As a secondary school teacher of Earth Science, I find that I get to visit almost all the areas which come under the "Earth Sciences" umbrella: Astronomy, Geology, Seismology, Meteorology, Oceanography, Volcanology, and anything else that is of interest in my students about the Earth.

Krystle Catalli, (BS, 2005): I graduated from UCSC in 2005 and then went directly to grad school at MIT and received my PhD this June in Geophysics. My thesis area was mineral physics. I am now a postdoc at Lawrence Livermore National Lab.

2006

S. Tyler Boss (BS, 2006): Commercial Diver, Global Diving & Salvage, Gulf of Mexico Oilfields.

Marci Beitch (BS, 2006): As an E&PS Alumni, I'm back at the E&PS dept! After 5 years of working (one at the USDA in Berkeley, CA conducting remote sensing research with Sarah Swope, and the last four in San Diego working for the geotechnical consulting firm, Ninyo & Moore), I've come back to UCSC as a Masters candidate working with Slawek in the field of glaciology. My M. Sci. research will be mapping the margin of the Greenland Ice Sheet from several different sets of satellite imagery, measuring shrinkage of the ice sheet over time, and calculating any changes in the rate of shrinkage in the recent years. I am very happy to be back in academia and back at UCSC.

2007

Samantha Hansen, (PhD, 2007): I've just started my 2nd year at the University of Alabama, where I'm working as an assistant professor. Much of my current research is still closely tied to the projects I had in Africa and Antarctica (which I started during my postdoc at Penn State), but I'm working on getting some new projects started too.

Julie Rokosky Ron (MS, 2007): I'm teaching 7th grade science at The Nueva School in Hillsborough, CA. The course focus is primarily chemistry, with a healthy dose of California geology. My husband and I recently moved from San Francisco to lovely, coastal El Granada. It's fun to be on the Pacific Plate again.

Steve Fercho (BS, 2007): I work as a Geologist and GIS Specialist for Ormat Technologies Inc. in Reno, where I've been for the last three years since completing my master's degree. Ormat is a geothermal energy company which specializes in exploration, development, and building power plants on geothermal resources. I'm involved in assessment of geothermal prospects internationally and across the western U.S. using geologic, geophysical, geochemical, remote sensing, and well data. I also work on compilation of all this data into GIS databases to produce relevant maps, with the ultimate goal of selecting locations for geothermal wells.

Mia Docto (BS, 2007): I am currently a graduate student at UC Berkeley studying Landscape Architecture and Environmental Planning. I am focusing my studies in river restoration. (And my graduate adviser is Matt Kondolf who also studied at UCSC and got his masters in Earth Science.)

2008

Brook Crowley, (MS, 2008): I have just started an assistant professorship at the University of Cincinnati. It's a joint position in the departments of Geology and Anthropology.

Alex Hutko (PhD, 2008): I'm now at the IRIS Data Management Center in Seattle which archives and distributes data for the seismology research community. I develop data products, some of which frequently appear in various media outlets following earthquakes of significant interest. I miss Santa Cruz, especially from October to July.

Darcy Ogden, (PhD, 2008): I'm currently an Assistant Professor at Scripps Institution of Oceanography.

Brina Mocsny (BS, 2008): I work for Naturebridge formerly Yosemite Institute, one of Outside Magazine's Top 50 Places to work, in Yosemite National Park as a field educator for nine months of the year. Naturebridge's mission is to inspire personal connections to the natural world and responsible actions to sustain it through environmental and experiential education. The most common academic subjects I teach are: climate change, hydrology, geology and ecology. During the other three months of the year, I am a Physical Science Technician working for with the National Park Service in Yosemite National Park. Physical Sciences encompasses hydrology, geology, air quality, soundscapes, and GIS. Recently, I have been working on field projects relating to the Merced River Plan, stock use in the park, and the status of the Lyell and Maclure Glaciers (with alumni Greg Stock).

2009

Devon Orme, (BS, 2009): In May 2011, I received my Master's Degree from the University of Arizona in experimental thermochronology. Upon completion, I headed to Tibet to begin my PhD work, which will focus of the sedimentology/stratigraphy and thermal history of the Xigaze forearc basin. I will be doing triple dating (U-Pb, fission track and U/Th-He) and Ar/Ar dating on numerous sections along strike. Tibet was an amazing experience to say the least!!! What a beautiful country!

Katharine Turkle, (BS, 2009): I am a graduate from the class of 2009 and I am working int the Earthquake Research Center at the USGS in Menlo Park now- I love it. :) I am currently in Richmond, VA, doing some field work on last week's 5.8 earthquake. Later this month traveling to the SCEC conference in Palm Spring and then AGU in December.

Ryan Haupt, (BS, 2009): I'm getting a Masters in Earth and Environmental Science at Vanderbilt University and continuing to podcast with fellow Earth and Planetary Science alums Patrick Wheatley and Charles Barnhart every week on our show *Science... sort of.*

Nathan Barth (BS, 2009): I took a job doing surveying for the Bureau of Land Management in Arcata. It's a seasonal job that's going to last into the fall. When that ends I think I'm going to stay here and get a certificate in GIS from HSU.

2010

Tina To, (BA, 2010): I am currently completing my Masters in Environmental Science through the University of Sydney. I have loved the opportunity to study abroad! I return to the US on Saturday and I will start the Ano Nuevo State Park docent training program next week. My daughter is 2 years old.

Pete Lippert, (PhD, 2010): I'm presently a post-doc in the Dept. of Geosciences at the University of Arizona in Tucson. My current projects include tectonic reconstructions of the Tibetan Himalaya and Greater India to reveal the suturing process between India and Asia, as well as development of new proxies for paleo-wildfire to explore relationships between climate change, seasonality, and wildfire susceptibility in the geologic past.

Charlie Lewis, (BS, 2010): I am a local climate action planner. My firm is PMC and we write climate action plans, sustainability plans, GHG reduction plans and so on for cities and counties all across the state.

Alex Morgan, (BS, 2010): After graduating from UCSC in 2010 I worked at NASA Ames for a year where I studied Martian geomorphology. I just started graduate school at the University of Virginia where I am working on a similar project (alluvial fans in Martian craters).

Nick Byler (BS, 2010): I graduated last December, and was thinking about applying to grad school, but I decided to delay that in order to work in the industry and gain experience. My goal is to take the GIT so I can obtain my PG certification. I have been working as a field geologist in south-eastern Utah since April doing exploration for an oil sands project. I believe this is the first project of this type in the US. It is similar to the oil sand project at Athabasca in Alberta, Canada, but I think they are trying to be more environmentally conscious here.

Patrick Kao (BS, 2010): I'm currently working as a Jr. Environmental Scientist for a company called Ahtna Facility Services, Inc here in Sacramento. It's a relatively small company and we are currently dealing with remediation efforts for one of the Bakersfield oil fields (Elk Hills, Former NPR-1). Right now I'm just basically writing reports for submittal to the Department of Energy and the California Department of Toxic Substance Control. However, we do have a field office there and I am going to do a bit of field work soon.

Nancy McKeown (PhD, 2010): Nancy McKeown is an assistant professor in Physical Sciences, Grant MacEwan University in Edmonton, Alberta, developing courses in and teaching GIS, remote sensing, and planetary geology. This past year, she presented at the community Mars Science Laboratory (MSL) Landing Site Workshops, contributing to the decision of where the MSL rover might land. ("Curiosity" will be landing at Gale Crater in 2012.) She has been continuing her research using imaging spectroscopy to map alteration minerals on Mars and is collaborating with Dr. Mark Furze, also at MacEwan, on his research in the arctic, using GIS to create maps of chemical distributions to determine the source of glacial ice on Banks Island.

We hope to see you at the Thirsty Bear Brewing Company for our
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When? **Tuesday, December 6, 2011**
from 6:00pm - 8:30pm

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