



NUHOU KANAKA PUKA

Department of
GEOLOGY & GEOPHYSICS
University of Hawai'i, Mānoa
Summer 2015

This issue is published in an electronic only format. The forests will benefit from this action.

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Nuhou Kanaka Puka

Nuhou Kanaka Puka ("Alumni News" in Hawaiian) published by the Department of Geology and Geophysics of the School of Ocean and Earth Science and Technology (SOEST) for its alumni and friends.

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GG and HIGP Team-Up to Identify Hawaii's Geothermal Energy Resources

As a remote island state, being the most dependent on imported fossil fuel in the nation, and having been created by one of the world's most active hotspots, Hawaii offers unique opportunities and advantages in developing geothermal energy. Imported oil supplies about 85% of Hawaii's electrical energy, leads to the highest per capita energy cost in the nation, and subjects the state to the whims of price fluctuations controlled by global economical and geopolitical factors. In response, the Hawaii Clean Energy Initiative (HCEI) promotes an aggressive shift away from imported oil by mandating that 70% of Hawaii's energy be clean, with 40% coming from locally generated renewables by 2030. Meeting this ambitious goal will require use of all of Hawaii's diverse, indigenous resources including wind, solar, hydro, biomass, and geothermal. The state's geologic, political, and economic landscape places Hawaii in an optimal position to lead the nation in this vital energy transformation.

Hawaii's single geothermal plant, Puna Geothermal Ventures (PVG) on Kilauea's east rift zone, opened in 1993 and has a proven track record of consistent productivity. However, geothermal's proportional contribution to Hawaii's renewable energy portfolio has quickly dwindled over the last few years (>25% in 2008 to <15% in 2013), lagging the growth of other sectors. The last comprehensive statewide assessment of geothermal resources occurred in 1983 and concluded that there are potential sites on all of the islands. Since then, a substantial volume of new geochemical, geological, and geophysical data have been gathered. A team of HIGP and GG researchers as well as GG graduate and undergraduate students have therefore been funded by the U.S. Department of Energy (DOE) to provide an updated assessment.

The first step in the project was to compile all available data pertaining to geothermal resources from various state, national, and academic entities. These data include native Hawaiian records of hot springs or fumaroles, surface geology and geologic ages, digital elevation models, well water temperature and chemistry measurements, rainfall, gravity, magnetotellurics, seismicity, and geodetic measurements. The data were inserted into numerous layers in a Geographic Information System (GIS) database, for qualitative spatial comparisons and analysis (Fig. 1).

The second step is to incorporate the different data types into quantitative models of resource probability using Bayesian statistics. The three primary qualities of a successful geothermal "play" are the presence of sufficient *heat (H)*, the *fluid (F)*

continued

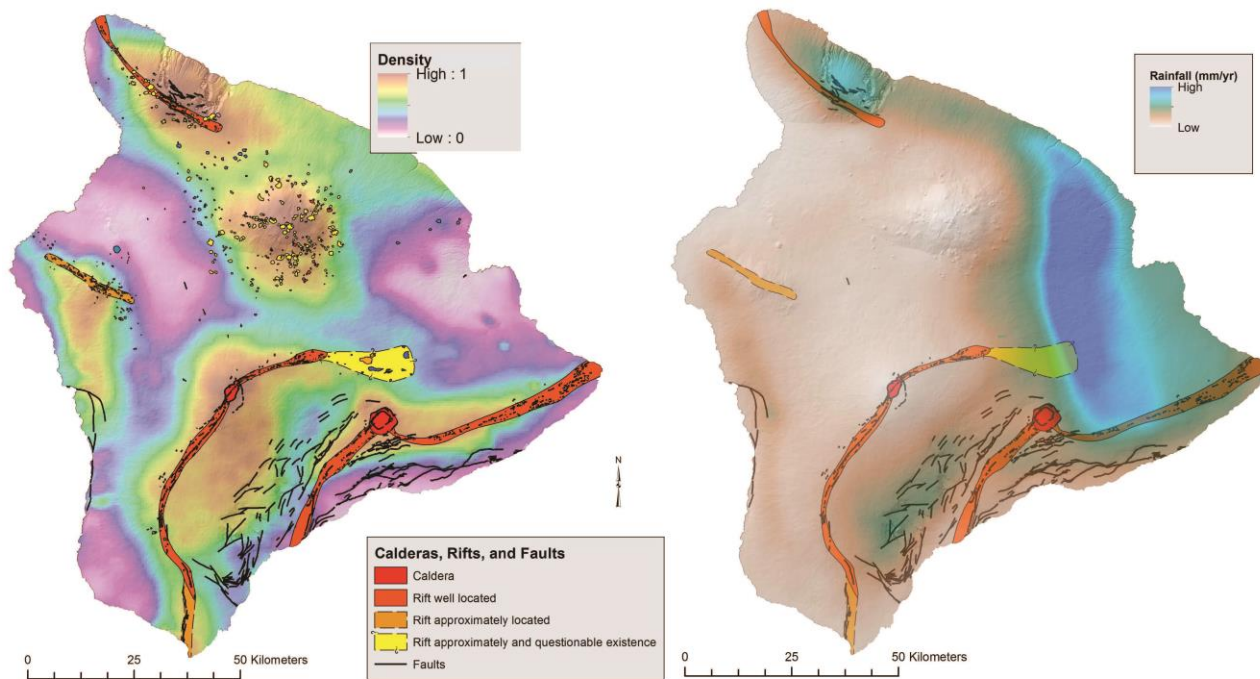


Fig. 1. Maps of the island of Hawaii from the GIS data base showing various datasets. (left) Color shades indicate crustal density anomalies produced from inversions of gravity (by GG alumnus **Ashton Flinders** [Flinders et al. 2013]), which is superimposed by mapped calderas, rift zones, and volcanic cones. These features are being used to identify locations possibly underlain by intrusive rock, which is the source rock for Hawaii’s geothermal heat. (right) Color shades indicate average rainfall, the source of Hawaii’s groundwater, which transports geothermal heat to the surface.

(i.e. groundwater), and *permeability* (P). Each of the above properties is informed by different data types. For example, the primary source of heat is dense magmatic intrusions, the likelihood of which is informed by the strength of the local gravity anomaly, the proximity to mapped rift zones, the age of the volcano (because rocks cool with age), and specific chemical indicators in well water. Ground water is the fluid that carries the heat to the surface, and is influenced by the amount of rainfall around the location and areas up the hydraulic gradient that feed groundwater to the area. Sufficiently high permeability at the appropriate depths is needed for a substantial flux of ground water to percolate from the hot rock to the extraction site at the surface, and may be informed by the presence of faults, seismicity, and ground deformation.

Preliminary maps of the probability of hot rock, permeability, and their joint probability for

Hawaii Island (Fig. 2) illuminate good prospect areas near the Kilauea’s active rift zone, Mauna Loa’s summit and southern rift zone, and the summits of the other older volcanoes. Discontinuities in colors indicate where data are absent; these gaps will be used to help locate areas of high priority for further surveying. In addition, near the two drill sites where hot water has been found (red stars), the predicted probabilities of heat are moderate or low, indicating that the parameters in our models need to be tuned or that other data should be included to produce more consistent results. Our future work will do just this, as well as assess the likelihood of all three desired qualities (*heat, permeability, and fluid*). The results will inform where further modeling or surveying efforts should take place to locate Hawaii’s most promising sites for geothermal exploration.

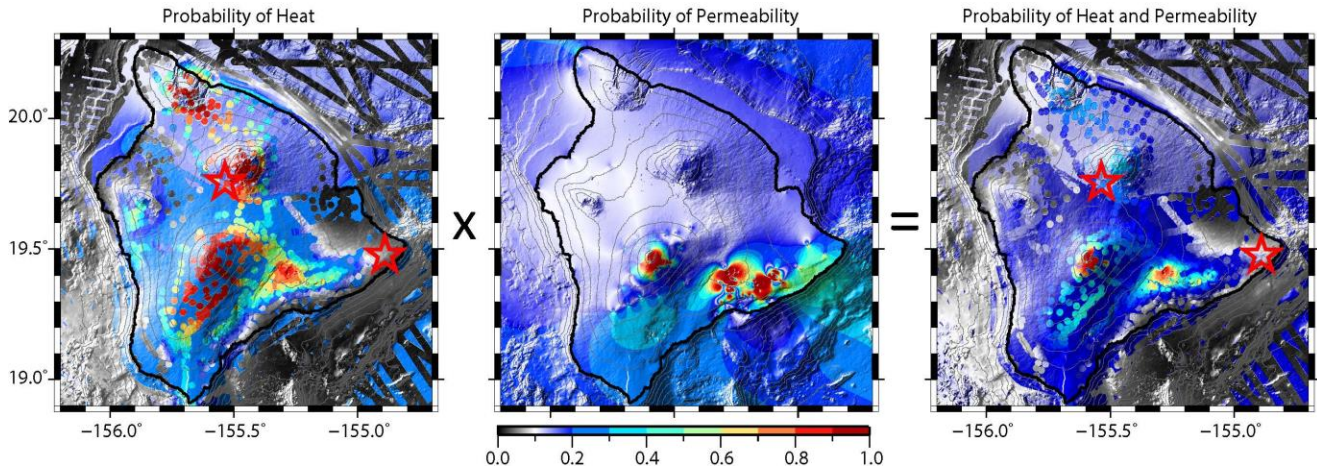


Fig. 2. (left) Map of computed probability of hot intrusive rock, which is a function of three data types: gravity anomaly, proximity to rift zones, and volcano age. Residual gravity anomalies are assigned to circular patches 3-km in diameter around individual measurements. (middle) Map of probability of high permeability as derived from horizontal strain rate as measured by the Pacific GPS facility-HIGP (provided by HIGP faculty member and GG alumnus, **James Foster**). (right) The product of the left and middle maps produce the joint probability of heat and permeability. In all cases, red indicates high probability, blue low, and white indicates areas where the probability is equal to the “prior” probability, or that without any data. Gray shades indicate where the probability is less than the prior. Red star on Kilauea’s East Rift Zone marks the location of Puna Geothermal; red star near Mauna Kea marks the Humu’ula Saddle Hydrologic Study Project drill site, where hot water was discovered.

Team Members

Nicole Lautze (GG alumnus, HIGP faculty & team leader)
 Donald Thomas (HIGP faculty)
 Garrett Apuzen-Ito (GG faculty)
 Neil Frazer (GG faculty)
 Nicholas Hinz (U. Nevada researcher)

Mark Brady (Hawaii, DLNR)
 David Waller (GG_MGeo student)
 Hannah Schuchmann (OCN-GES major)

The authors: Garrett Apuzen-Ito, Neil Frazer, and Nicole Lautze

* * *



GG 103 field trip to Kaua’i.

Message from the Chair



Aloha!

With last academic year now a pleasant memory and preparations for 2015-16 underway, it is tradition to use this space to share with the GG 'Ohana reflections on where we've been and where we are headed.

Exciting major changes are coming to the Geology BA degree in Fall. The degree now has two pathways, one in Environmental Earth Science and the other in Earth Science Education, and the old single degree path has been deleted. These changes respond to the needs of our students and evolving workplace demands, particularly in the environmental sector.

In Faculty and Staff news, we congratulate Julia Hammer for receiving a UH BOR Teaching award, Mike Garcia for being made a Fellow of AGU, and Rob Dunn for his promotion to Full Professor. We also said goodbye to very long time department member Evelyn Norris when she retired this past January and wish her all the best in the coming years.

It has been an interesting first year for me as department chair, with new opportunities and challenges for personal and departmental growth. Perhaps the biggest challenge comes from the evolving landscape in public higher education in Hawaii and nationally: there is a trend towards greater emphasis on instructional activities over research, expectations of increased numbers of students served and degrees granted, and a desire to quantify faculty productivity, all in the context of diminishing

state support, particularly for the research side of our mission. The University of Hawaii is no stranger to these trends. And with few friends in State government these days, these circumstances make the current climate on campus charged. It also makes for some interesting introspection throughout the university about things like quantity and quality of output, the importance of student-faculty ratio, academic workload, and balancing research and teaching.

There are already very positive signs from GG's new push to enhance its instructional activities. Faculty are teaching more, students have more access to courses (such as more 100-level offerings each semester and twice annual offerings of our two required 200-level courses), and enrollments are rising. I am happy to announce that *we have increased undergraduate student enrollment 25% over the past year*, a feat unmatched throughout SOEST (where other units saw essentially no change or single digit increases). Our enrollment increase leadership should come as no surprise: GG has always been a premier teaching and research program, offering a full suite of well recognized undergraduate and graduate degrees for many decades, and yet also adapting to the times with new degree offerings, such as our MGeo program and revised BA degree.

Like all of SOEST, GG has long been a place of vibrant and productive research activity. As the department responds to these challenges and does more teaching, we are considering how to also keep our research enterprise moving along. Diminished access to federal funding for science, particularly in the Geosciences, makes it increasingly difficult for faculty and graduate students to carry on with this work.

There will always be challenges so the approach we are taking is to work smarter and to strive to work more as a group to maintain the research enterprise while we grow the instructional side of things. This sometimes means making tough choices about which activities to pursue and setting aside less fruitful endeavors. But I am sure GG is up to the challenge.

We are very grateful to our friends and alumni for continued financial support. Your gifts make a real difference for our students and our program. If you have not already done so, please consider a (tax deductible) contribution to one of the Department's funds (see the last page of this Newsletter for a copy of the form or click the "donate" button on the GG home page). Every bit you contribute directly helps our students. Thanks to all of you who have made contributions!

Please visit the GG website at www.soest.hawaii.edu/GG/ regularly for updates, job opportunities, special announcements, course listings, curricular plans for the next 5 years, information about our degree programs and profiles of GG members.

Finally, I would like to welcome our new and returning undergraduate and graduate students, and wish them all success in the coming years.

Ken Rubin, Chair

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Degrees, Awards & Honors



GG "Sweet Success" party, Spring 2015. *K. Rubin, B. Mintz, M. Makalena, L. Froberg, E. Kakone, T. Leonhardi.*

Undergraduates

Christopher Sadoyama	<i>BS Fall 2014</i>
Lauren Froberg	<i>BA Spring 2015</i>
Daniel Bishton	<i>BS Spring 2015</i>
Alexander Krause	<i>BS Spring 2015</i>
Mariya Makelena	<i>BS Spring 2015</i>
Bianca Mintz	<i>BS Spring 2015</i>

Masters of Science

Sarah Glancy – Thesis: *Petrology and Geochemistry of Boninites and Related Lavas from the Mata Volcanoes, NE Lau Basin* (Advisor: K. Rubin, Fall 2014)

Jessica Zaiss-Bowman – Thesis: *Osmium Geochemical Behavior and Global Isotopic Changes Associated with the Cretaceous-Paleogene Impact* (Advisor: G. Ravizza, Summer 2014)

Dana Brodie - Thesis: *Analysis of Acoustic Signals Detected on an Ocean-bottom Seismograph Array in the Lau Basin, South Pacific Ocean* (Advisor: R. Dunn, Spring 2015)

Samantha Jacob – Thesis: *Characteristics and Origin of Erosional Resistant Units in the Mars Science Laboratory Landing Ellipse (Gale Crater Mars) Based on Analysis of Surface Data, Orbital Images and Crater Densities.* (Advisor: S. Rowland, Spring 2015)

Harrison Togia – Thesis: *New Constraints on Temporal Variations in Hawaiian Plume Buoyancy Flux* (Advisor: C. Conrad, Spring 2015)

Christine Waters - Thesis: *Submarine Groundwater Discharge and Related Variability in Coastal Water Chemistry: North Kona District, Hawai'i* (Advisor: H. Dulaiova, Spring 2015)

Coursework Masters

Kimberly Binsted - Advisor: G. Huss, Spring 2015

Brian Boston - Advisor: G. Moore, Fall 2014

Joseph Fackrell - Advisor: C. Glenn, Spring 2015

Emily First - Advisor: J. Hammer, Spring 2015

Kendra Lynn - Advisor: M. Garcia, Spring 2015

Doctor of Philosophy

Patrick Gasda – *The Aqueous Alteration of Carbon-Bearing Phases in CR Carbonaceous Chondrites* (Advisor: G. J. Taylor, Fall 2014)

David Trang – *A Remote Analysis of the Lunar Landscape* (Advisor: G. J. Taylor, Fall 2014)

Katharine Robinson – *Water in Evolved Lunar Rocks* (Advisor: G. J. Taylor, Spring 2015)

Student Awards

Agatin Abbott Memorial Award

Presented to the outstanding senior, annually, in memory of department faculty Agatin Abbott.

Tanis Leonhardi , Bianca Mintz

Fred M. Bullard Fellowship

Endowed by Thais Freda Bullard in memory of her father, Fred M. Bullard, a pioneer in the studies of Volcanology and general Geology & Geophysics. TBA

William T. Coulbourn Fellowship

Endowed by friends and family in memory of depart-ment alumnus / faculty member Willam T. Coulbourn. Katie Taladay

Harold T. Stearns Fellowship

Endowed by longtime department friend for the purpose of supporting student research on geological and geophysical problems in Hawaii and the Pacific Basin. Brian Shiro, Christina Richardson

J. Watumull Scholarship

Awarded annually to the department's outstanding graduate student from an endowment from the Watumull Foundation. TBA

GG Achievement Scholarships

Award based on merit service, achievement and outstanding grades of graduates. James Bishop, Erin Fitch, Sarah Glancy, Kendra Lynn, Brian Shiro Katie Taladay, Jonathan Tree

Other Fellowship, Scholarships & Awards

Hannah Azouz and Trista McKenzie - *Undergraduate research opportunities program fellowship.*

Samuel Wall - *Stephen Lau Scholarship and Surfrider Award*

Faculty – Promotions, Awards & Honors

Robert Dunn *promotion to full Professor, August 1, 2015*

Michael Garcia - *AGU Fellow 2014.*

Julia Hammer - *2015 UH Board of Regents Excellence in Teaching Award.*

* * *

Julia Hammer wins UH Board of Regents Excellence in Teaching Award

Julia Hammer was awarded a prestigious UH BOR Excellence in Teaching Award in Spring 2015 for teaching success, including creative and innovative teaching methods. She was among 6 Manoa faculty members to receive the award this year. Julia was recognized for going the extra mile to engage with students in her courses, especially GG301 (Mineralogy) and GG602 (Theoretical Petrology), and for bringing content alive with in-class demonstrations and hands-on exercises. Her activities also include running a professional development program for K-12 Earth Science teachers. Her nomination and most of the supporting letters came from current and former students. Julia described her contributions to GG as bringing “expertise in the study of rocks and magmas”, but I hope you will agree that her contributions to the GG teaching program are much more than that. The words of two of the folks who wrote letters for her nomination sum it up nicely: “Because of Julia, I love Geology and feel like I belong in a department.” And, “although I had learned a lot about mineralogy, the most important thing I had taken from Dr. Hammer was that science was awesome.”

* * *



*Science Alive at Bishop Museum was held March 15 with strong presence from
GG faculty and graduate students.*

* * *

2014-2015 GG Research and Teaching Highlights

Garrett Apuzen-Ito is having great fun teaching GG101 for the first time. His newest research pertains to assessing the potential for geothermal energy in Hawaii using statistical models. He is funded via a DOE grant awarded to **Nicole Lautze**. Collaborators include **Neil Frazer**, **Don Thomas**, and MGeo student **David Waller**. Congratulations to former post-doc **Maxim Ballmer** for securing a research position at the Earth-Life Science Institute, Japan, and for a future position at ETF, Zurich Switzerland. Also former post-doc **Alejandro Gallego** is now doing financial modeling at First Hawaiian Bank. And congratulations to former student **Todd Bianco** and his wife **Alison** on the birth of their first child. Garrett is also collaborating with former student **Eric Mittlestaedt** (now a professor at the Univ. of Idaho) in developing numerical models that simulate faulting in 3D.

Janet Becker's highlights from academic year 2014-2015 include working with graduate student **Svetlana Natarov**, teaching GG/OCN312 and GG600, and publishing **Christine Pequignet's** (PhD, 2012, now at UWA) main dissertation result in JGR. Additional research on observations and estimates of wave-driven water level extremes at the Marshall Islands was published in GRL. The numerical modeling component of the Marshall Islands project continues with former postdoc, Yao Yu (now at Changsha University of Science and Technology). **Nicole Deyerl**, a mathematics undergraduate, began working on the forcing of long waves over reefs. Nicole will graduate this spring and start graduate school in Applied Mathematics at SMU next fall. Former undergraduate GES student **Hyang Yoon** now is in a PhD program at UPenn in Ocean and Climate Dynamics.

Clint Conrad and his research group have been developing a number of different research topics this year that relate to intraplate volcanism, planetary convection, sea level change, and patterns of mantle flow. This year Clint wrote articles on the scientific history of plate tectonics and the relationship between ice ages, sea-level, and the abyssal hill topography of the seafloor. Postdoc **Maxim Ballmer**, who recently left Hawaii for a research scientist position at the Earth-Life Science Institute in Tokyo, also published a paper that explains patterns of recent basaltic

volcanism around the edges of the Colorado Plateau in the southwestern United States. Graduate student **Harrison Togia** successfully defended his Master's thesis on the evolution of Hawaiian swell topography. The Conrad research group welcomed **C. Evan Watkins** during this past year. Evan has already started a research project designed to constrain the component of seafloor topography that is generated by the convective dynamics of Earth's mantle.



*The Coastal Hydrology and Geochemistry team has participated at the Science Alive outreach event at the Bishop Museum. Our exhibit on water resources, water quality and its effect on the coastal environment was a great success. Left to right: **Henrietta Dulai**, **Chris Shuler**, **Joe Fackrell**, **Christina Richardson**, **James Bishop**, **Kristen Glenn**, **Craig Glenn**, and **Aly El-Kadi**. Not shown, but also participated: **Christine Waters**, **Sam Wall**, and **Joe Kennedy**.*

Henrietta Dulai and her research group are happy to welcome two graduate students, **Christina Richardson** and **Samuel Wall** who joined our research group in Fall 2014. Both are recipients of the prestigious National Science Foundation Graduate Research Fellowship Award. Christina has been working on submarine groundwater discharge in Maunaloa Bay, Oahu and Sam is preparing for a project on quantifying pesticide fluxes to the coastal zone on south Kauai. Two undergraduate students joined the lab and have been working with Dulai on Fukushima-derived radionuclides. **Hannah Azouz** is looking into cesium distribution in fish across the Pacific Ocean and **Trista McKenzie's** study hopes to quantify atmospheric cesium deposition on the main Hawaiian Islands. These studies have been funded by the University of Hawaii Undergraduate Research Opportunities Program.

Graduate student **Christine Waters** defended her MS thesis on submarine groundwater discharge in Kona, HI in April 2015. We congratulate Christine and wish her good luck! Dulai has continued her collaboration with graduate student **Chris Shuler** studying water resources and water quality in American Samoa.

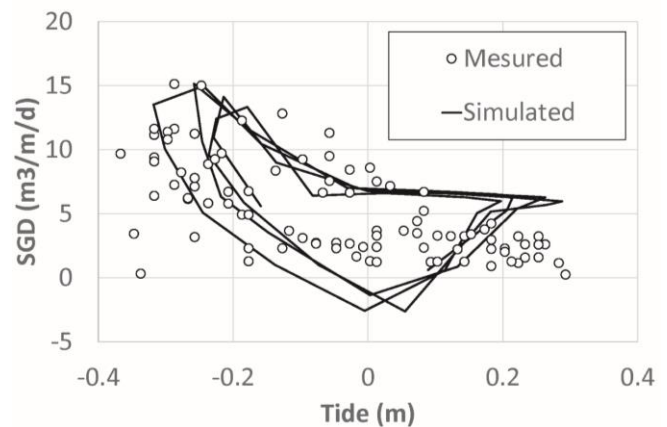


Christine Waters explaining the link between groundwater quality and its effect on the coastal zone.

Robert Dunn's research group continues to develop new research avenues related to the tectonic and magmatic evolution of mid-ocean ridges, arc and back arc systems, and hotspots. His team has also branched out further afield into areas of bioacoustics, carbon sequestration, and physical oceanography. Congratulations to graduate research assistant, and **Bullard Fellow, Dana Brodie** who successfully defended her thesis research on bioacoustics; her first paper was published earlier this year. Robert's studies of the Lau back-arc spreading centers resulted in several new publications in the past year (including one in the journal *Nature*) and his 2013 cruise to the Mid-Atlantic Ridge has the whole lab busy working out results for another set of publications. M.S. student **Adela Dumitrascu** is beginning her work on carbon sequestration monitoring via geophysical techniques, while Ph.D. candidate **Silke Ballmer** is finishing her work on Big Island seismic structure and is currently on leave of absence in Tokyo, Japan. **Dr. Deborah Eason** is working with Robert on models for the petrogenesis of oceanic crust in water-rich back-arc environments, while Robert and **Garrett Ito** have continued their collaborations on the geodynamics of

ridge-hotspot interaction. This year, Robert completed another term as a Manoa Faculty Senator.

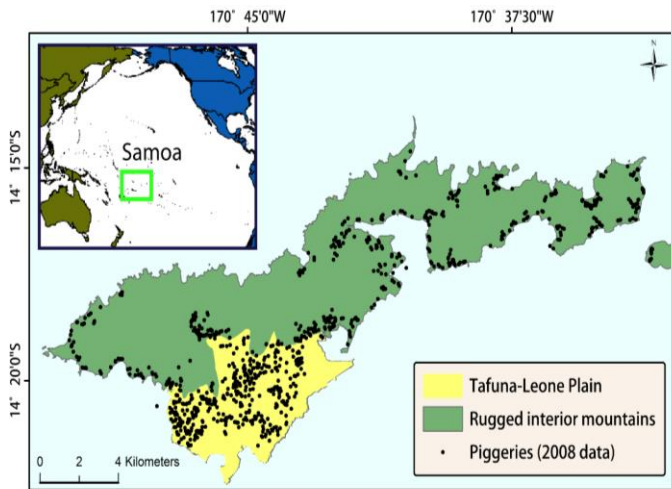
Aly El-Kadi's hydrology group includes graduate students **Chris Shuler** and **Kariem Ghazal**, and postdoctoral fellow **Olkeba Tolessa**. He is cooperating with other faculty members in the Hydrology and Coastal Groundwater Research Group, **Craig Glenn** and **Henrietta Dulai**. El-Kadi's current research deals with the effects of climate change and variability and land-use changes on water sustainability. Climate change refers to long-term variations, while climate variability refers to shorter time episodes, such as drought and El Niño Southern Oscillation (ENSO). Under different climate scenarios, output from climate models, including precipitation and temperature, is used to estimate groundwater recharge. The recharge is used as input to subsurface models to assess subsurface effects. Sustainability indicators include water levels, spring flows, and water quality. Studies cover Oahu, Maui, Jeju Island (South Korea), and American Samoa. His work also deals with modeling of submarine groundwater discharge (SGD). Understanding and accurately modeling of SGD are essential elements in assessing the interaction between the land and ocean. SGD carries pollutants that can cause ocean quality deterioration.



The figure above compares the measured vs estimated SGD for a site on the Big Island of Hawaii. The data and modeling results show the hysteresis behavior of SGD values (that is the data follow different pathways as water moves from the land to the ocean or from the ocean to land under tides).

Another on-going project is dealing with assessing ground water sustainability of the Island of Tutuila,

American Samoa. It is aimed at Identifying potential contamination sources in well capture zones, assessment of wells under the direct influence of surface water to evaluate potential surface water contribution, assessing sustainability under current and future water uses including scenarios of climate change and variability and land use changes, and Identifying potential land-use impacts to wells, including inputs from soils, fertilizers, cesspools, septic tanks, and piggeries.



Tutuila's mountains are relatively pristine and unaffected by the anthropogenic contaminants that are prevalent on the Tafuna-Leone plain.



GG455 excursion to the Board of Water Supply's 1,500 foot vaulted dike water supply at Waihe'e Tunnel.

Chip Fletcher and the Coastal Geology Group had a great year. Post-doctoral scholar **Tiffany Anderson** is modeling future wave flooding and coastal erosion under higher sea levels and providing the data to the Hawaii Climate Adaptation Committee for their report on adapting to sea level rise in Hawaii. **Matt Barbee** is hard at work posting Tiffany's data on the Pac-IOOS website in the form of maps showing the probability of exposure to higher sea level. Matt is also updating Hawaii LiDAR and historical shoreline data using products from the U.S. Army Corps of Engineers. **Haunani Kane** finished her MS in 2014 (with 2 papers on sea level impacts to coastal wetlands) and is now working on her Ph.D. **Shellie Habel** graduated with her BS in GG and is now a Masters student working on two projects: 1) groundwater inundation associated with rising sea level, and 2) performance of sand nourishment at Waikiki.

Neil Frazer continues to work in coastal geology, with **Chip Fletcher**, **Tiffany Anderson** and students in the coastal group. He is also working with **Don Thomas**, **Nicole Lautze**, **Garrett Ito** and students in a new geothermal exploration effort for Hawaii, and with Rhett Butler to estimate the probability of a major tsunami in Hawaii. Recently he worked with graduate student **Sam Howell**, colleague **Bridget Smith-Konter** and others to show that vertical GPS data along the San Andreas fault system carries important tectonic information. For this spring, Neil reorganized and retitled his graduate course in data analysis — it is now called Bayesian Data Analysis — attracting students from many other departments on campus as well as from G&G.

Craig Glenn and students **Joseph Fackrell**, **James Bishop**, **Joseph Kennedy**, **Christopher Shuler** and **Dan Amato** are pursuing projects and quests to locate and map point-sourced and diffuse groundwater discharge to the ocean and tag and trace those waters and their chemical loads back to their sources on land, throughout the Hawaiian islands and in American Samoa. The team's latest quests and results include stable isotope mapping with macroalgae, CFC dating of groundwaters, particle source back tracking and nutrient source partitioning, stoichiometric modeling of nutrient transformation reactions, and augmenting our existing heavy aircraft remote sensing capabilities with remote controlled aerial thermal infrared drones.



Craig Glenn experimenting with use of infrared drones for detection and mapping of submarine groundwater discharge.

Julia Hammer continues to study igneous processes in a variety of settings. A collaboration that includes **Lisa Petrochilos** (BS '07 and MS '10, now at Schlumberger in France) and **Julie Bowles** (former postdoc, now Assistant Professor at the University of Wisconsin) examines the influence of slow cooling on magnetic properties of igneous titanomagnetite (Brachfeld et al., *Geophysical Research Letters*). The long-awaited final dissertation publication (Brugger and Hammer, *American Mineralogist*) from **Carrie Brugger** (PhD '11, now lecturer at Northern Arizona University) reveals that twinning associated with rapid crystallization promotes swallowtail morphologies in the absence of diffusion gradients. Graduate student **Emily First** attended a MELTS workshop at Caltech in the spring and is wrapping up her study constraining the cooling rate of a martian basalt. Emily is also mentoring undergraduate **Diamond Tachera** in the lab on her project concerning magma from a Chilean volcano. Undergraduate **Tanis Leonhardi** is

completing thesis projects concerning the eruption of the Puu Waawaa trachyte cone with **Tom Shea** and superheating on crystal nucleation in Oahu's Sugar Loaf basalt. Tom tackled the problem of discriminating secondary meteoric water from primary magmatic water (Giachetti et al., *Geochimica et Cosmochimica Acta*), and continues to develop numerical and analytical methods to study element diffusion in olivine. **Benoît Welsch** (postdoc) returned to UH in the spring to continue collaborative projects involving crystal-rich lavas from Maui.

Bruce Houghton's graduate student population is rising to six with addition of three new students (1 PhD; 2 MS) in August. Bruce's assistant **Kristine Kosinski** (now **Curran**), has married and left for Oregon to be closer to her extended family. **Wendy Cockshell** has replaced Kristine. This year has seen a record number of undergraduates employed in the volcanology laboratories, eight in total.

The group presented 12 papers at Fall AGU, two at EGU in Vienna, Austria, and two at Cities on Volcanoes 8 in Yogyakarta, Indonesia. The volcanology group played a significant role in the science response to the Puna lava flow crisis, in particular, students in GG601 were able to assist HVO senior scientists in the mapping of the flow front as it advanced to the outskirts of Pahoia (Figure 1). At the same time we have been working constantly summit activity at Kīlauea published papers in Geology, EPSL and Nature Geosciences.



Figure 1: GG-601 student Val Findlayson assists HVO gas chemist Jeff Sutton with mapping of the advancing lava flow front during the 2014-2015 lava flow crisis in Puna.

The new research initiative at Novarupta, Alaska, centered on **Samantha Weaver's** PhD, is going extremely well following a 3-week field deployment in August. An NSF Oceans award to **Rebecca Carey** and Bruce Houghton funded a Kermadec cruise in April to Havre volcano, to document products of a large explosive eruption in 2012. Samples collected form the basis for a PhD study by **Sam Mitchell**, a former University of Bristol student. The Phantom high-speed camera was been deployed repeatedly at Halema'uma'u and in May during a 10-day campaign at Stromboli (Figure 2). This has been a very profitable collaboration with Italian (INGV, Rome, Palermo, Catania), and British (Cambridge, Manchester) institutions and with HVO, producing 5 papers at 2014 Fall AGU, and 3 at 2014 EGU.

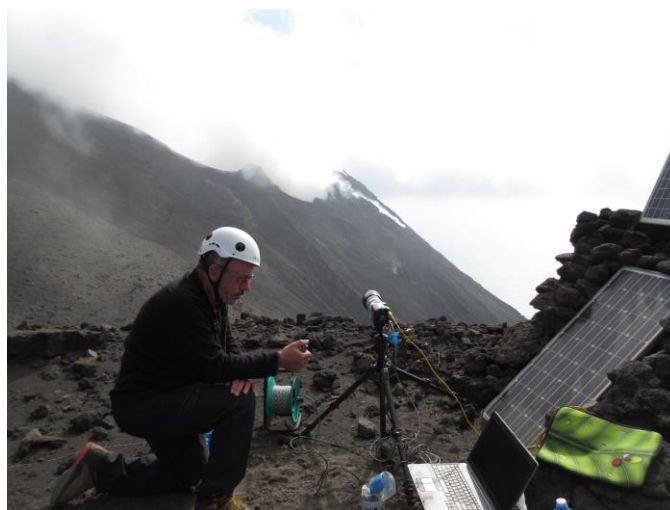


Figure 2: Bruce Houghton 'triggers' explosions at Northeast Crater during the May 2015 deployment of the Phantom high-speed camera at Stromboli. Note use of 'clean, green' renewable energy supply.

Our group's very profitable relationship with the National Disaster Preparedness Training Center continues. We led FEMA volcano crisis trainings in Honolulu, San Francisco, Red Bluff, CA, Long Valley, CA, and Buffalo, NY and participated in the executive-level Science of Disasters course held for FEMA in Emmetsburg, Maryland.

Hope Jahren and her lab have continued their work on the effects of atmospheric CO₂ concentration on various facets of modern and paleo plant biology; Hope was featured at the 2014 Goldschmidt Meeting as a keynote speaker, in order to reflect upon the last twenty years of her research trajectory.

Robert Graper, a sophomore engineering student, has finished constructing a computer controlled solenoid system allowing for automated sampling of air within the lab's indoor plant growth chambers. These modifications have allowed the lab to conduct numerous growth experiments at elevated atmospheric CO₂ concentrations with unprecedented control of environmental conditions, the results of which have been used to further explore the effects of elevated CO₂ concentrations on the plant fossil record. The lab's environmental nutrition program has experienced considerable growth in the past year, with continual refinement of a stable isotope biomarker of added sugar intake and a recent collaboration with the USDA's Nutrient Data Lab to construct a national food stable isotope database for standard reference. Combining our passion for growing plants and talking about nutrition, technician **Josh Bostic** is working

closely with the University of Hawaii's STEM Pre-Academy Program to develop a three-module outreach program to concurrently teach children about sustainable, local agriculture and the health benefits of plant-based diets through a series of school-based gardening activities and health workshops in local middle schools. We look forward to the graduation of **Sherilyn Palafox** (B.S. soon!) and welcome her ongoing contributions to the lab as she chooses between medical schools. Congratulations go out to former lab member **Ben Czeck** (M.S. 2014), who recently landed his "dream Job" as an environmental scientist helping to assess sites for wind energy installation at Tetra Tech, Inc. near Minneapolis, Minnesota.

Lab manager **Bill Hagopian** completed another successful field season in Cherskiy, Eastern Siberia, collecting mummified wood from Pleistocene and Miocene age deposits. These exceptionally well-preserved wood specimens, with intact ring and cellular structures, will be suitable for fine scale intra-ring sampling for carbon and oxygen isotope analysis used to infer seasonal climate information.



Bill Hagopian holding a Pleistocene aged buffalo fossil near Cherskiy, eastern Siberia (Russia).

Jasper Konter's research has focused on mainly two topics: using radiogenic isotopes to recognize a third long-lived (Rurutu) hotspot track, and using various isotope systems to understand volcanism in Samoa. The Rurutu hotspot project is an NSF funded project that is part of PhD student **Valerie Finlayson's** work, and in collaboration with **Anthony Koppers** (OSU) and **Matt Jackson** (UCSB). The laboratory techniques developed for this work were published with a paper in Chemical Geology. Applying these methods, we can now trace the hotspot that starts near Rurutu (Cook-Austral Islands) with seamounts in between Samoan volcanoes, and as volcanoes of the Tuvalu Islands, Gilbert Ridge, into the Marshall Islands. This hotspot defines a third major hotspot trail in the Pacific Ocean basin next to Hawai'i and the Louisville Seamounts, and extends further back in time providing new data for Pacific plate motion. The second topic, Samoa, led to a co-authored publication in Nature (with **Matt Jackson**) that shows that Samoan lavas are a microcosmos of global isotopic variations in hotspot lavas. We are currently working on a comparison of Samoan volcano building with Hawaiian volcanoes, and finishing a study of stable iron isotopes that imply unusual mantle source compositions in Samoa. Another iron isotope study that is nearly finished (by **Valerie Finlayson**) develops a new measurement technique and tests it on a set of mantle minerals included in lavas. Finally, in collaboration with **Shiv Sharma** and **John Porter** (HIGP), we are working on development of Laser Induced Breakdown Spectroscopy techniques for field-deployed first-order compositional analysis, and characterization of a large dredge sample set. Jasper also attended an Ocean Exploration/NOAA workshop for target selection of their telepresence-enabled exploration, and a science plan workshop for NSF's Cooperative Studies of the Earth's Deep Interior.

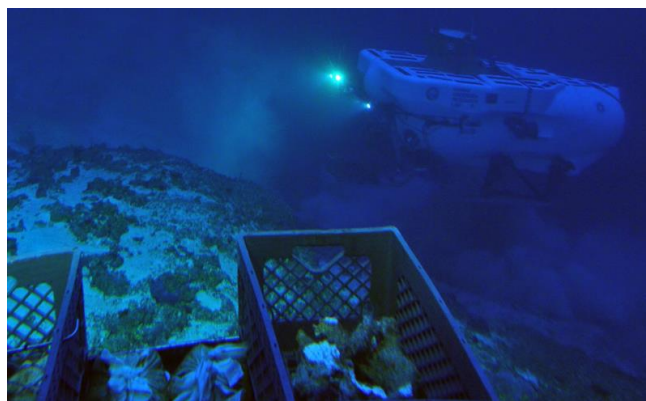
Greg Moore's group continued research on convergent margin tectonics and sedimentation. Graduate student **Brian Boston** continued his work on the region of the Japan Trench that was affected by the 2011 Tohoku earthquake. His paper on Pacific Plate normal faults subducting at the trench and their influence on the accretionary prism was published in November.

Graduate student **Katie Taladay** participated in IODP Expedition 353 that studied the Indian monsoon. She collected core physical properties data and pore water samples from several drill holes around the northern Indian Ocean. She has also been finishing her work on methane hydrates in the Nankai Trough.

Greg continued work on the Nankai forearc basin, submitting a review paper on the basin's sedimentary history and another on large landslides in the basin. He conducted a third short field study of ophiolite fragments and mud volcanoes exposed on two islands offshore of western Myanmar in the eastern Indian Ocean.

Brian N. Popp continues his isotope biogeochemical research focusing on nitrogen cycling in marine environments, marine food web studies and the marine mercury cycle. **Joy "Leilei" Shih** (Oceanography Ph.D. Student) is examining the importance of ammonia oxidation and denitrification associated with sponges on the nitrogen budget of reefs in Kaneohe Bay, Oahu. Joint with **Jeffrey Drazen** (UH Oceanography), **Cecelia Hannides** (G&G Assistant Researcher), **Kanesa Duncan Seraphin** (UH Sea Grant Center for Marine Science Education) and **Hilary Close** (SOEST Young Investigator and NOAA Global Change Research Fellow) we are using amino acid compound specific nitrogen isotope analyses to study the trophic ecology of meso- and bathy-pelagic organisms in the ocean north of Oahu. This group is also using trophic positions derived from isotopic analyses of amino acids to examine methylmercury bioaccumulation in pelagic fishes and zooplankton and, in combination with isotopic analysis of mercury (with **Joel Blum**, University of Michigan), we hope to better constrain mercury cycling in the ocean. Check your local television schedule for our upcoming Voice of the Sea documentaries on these two projects.

Ken Rubin continues to split his research activities between deglacial sea level studies with **Chip Fletcher**, mid-ocean ridge volcanism with **John Sinton**, **Dave Clague** and others, and submarine boninite volcanism in Tonga with just finished graduate student **Sarah Glancy** (MS 2014), **Eric Hellebrand** and a group of international collaborators. His sea level research in 2014 included 5 new Pisces V submersible dives at Penguin Bank with former GG grad students **Clark Sherman** (PhD 2000) and **John Rooney** (PhD 2002) – see picture. Ken also participated in a second year of study of 2011 and other submarine lava flows at Axial Volcano (NE Pacific) with an MBARI team and their ROV Doc Ricketts. Ken is also playing a leading role in governance of the NSF EarthCube community and busy with a U-Th Geochronology Cyber Infrastructure project. His first year as GG dept. chair has been eventful and is keeping him busy.



Rare view of Pisces IV sub from Pisces V during our 2 sub operations at Penguin Bank, Hawaii. HURL is the only group in the world to operate a 2-sub capability, which is very useful for detailed mapping and sampling of submerged coral reef structures.

Bridget Smith-Konter and her crustal deformation research group have had a busy but productive year getting settled in at UH. Bridget recently finished an exciting study with Ph.D. student **Sam Howell** and **Neil Frazer** that investigated anomalous vertical rates of ground motion in southern California associated with earthquake cycle loading. Bridget also worked with postdoctoral scientist **Arjun Aryal** on improving computational crustal deformation codes to better study faulting mechanics of recent earthquakes on the Big Island. In collaboration with research colleagues at SIO, Bridget published three papers on seismic moment, geodetic slip rates, and vertical motions constrained by tide gauge data spanning the North American-Pacific plate boundary.

Bridget also welcomed new Ph.D. student **Marissa Cameron** and new G&G major **Liliane Burkhard** to her growing icy satellites research group. In collaboration with JPL colleagues, the team embarked upon an exciting NASA-supported project to map strike-slip morphological features on the surface of Jupiter's largest moon, Ganymede, using high-resolution Galileo spacecraft imagery. Soon they will begin integrating these mapped structures into a global tidal stress model to investigate global mechanisms for the evolution of strike-slip faulting on Ganymede.

On the educational front, this year Bridget also began working with teachers and students at Manoa and Wai'ālae elementary schools in an effort to install an interactive Earth science kiosk in each school's library. These IRIS-developed educational kiosks are supported by an NSF-Career grant to help broaden public awareness and appreciation of the Earth sciences. Bridget is teaching her second semester of

GG105 (*Voyage Through the Solar System*) this semester, where she has successfully recruited 3 new G&G majors.

Steve Stanley has been working with his postdoc, **Sonia Rowley**, on the reason there are so few bivalve mollusks living in the shallow waters surrounding Oahu. It appears that water movements are too strong to allow all but a few rapid burrowers to exist in these waters. We are investigating the instability of sand bodies and evaluating species distributions in shallow and deep waters.

In the fall I published a paper explaining a remarkable evolutionary pattern: the dramatic evolutionary radiation of the lucinid bivalves beginning in the very late Cretaceous. I attribute this to the appearance of mangroves, and especially seagrasses, which now provide the favored habitats for these burrowers.

I am finally able to deal with the page proofs of two long chapters for the second edition of the *Treatise on Invertebrate Paleontology* volume on bivalve mollusks.

On the theoretical side, I am working with my former student **Matthew Powell** on a computer program investigating the nature of “species selection,” the process analogous to natural selection at the individual level, which I believe accounts for most large-scale evolutionary trends. In quite a different domain, I am completing a huge multi-year project on the environmental stratigraphy and bivalve paleoecology of the Pliocene Pinecrest Formation of Florida, which I can show represents a transgressive barrier-island lagoon complex, complete with a hurricane-induced washover fan in which a large

group of cormorants, blown out of their roosts, were slapped down and buried alive or moribund. I am also working at the Smithsonian on a taxonomic monograph on the Pinecrest bivalve fauna (more than 200 species!).

Paul Wessel continues work on GMT 5, the most recent incarnation of the Generic Mapping Tools. The new version has been completely redesigned as an Application Program Interface (API), which allows new infrastructure to be built on top of the GMT library, thus enhancing interoperability with other common platforms such as MATLAB and Octave. We also have an active collaboration with Scripps and the University of Michigan funded by NSF/Geoinformatics to strengthen GMT’s role in seismology, radar interferometry, geodesy, and high-performance computing, and to develop a Python interface to GMT. Right now we are readying a new proposal to NSF EarthCube, trying to tap into a new source of funds.

Sometime next year, Wessel will continue his work in plate tectonics when he is set to lead an oceanographic expedition to the remote Ellice Basin between the Ontong Java and Manihiki Plateaus in the South Pacific to investigate the modes of opening of this basin that formed during the Cretaceous Superchron, thus no magnetic anomalies are expected and we will be relying on the dating of dredged rocks. Between bouts of proposal and manuscript writing and teaching courses he tries to spend some time with his family, who he hears is really nice.



THE GENERIC MAPPING TOOLS

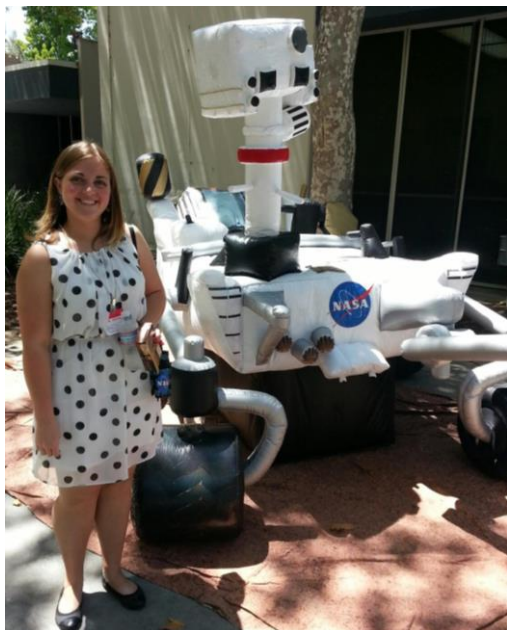
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Alumni News

Carrie Brugger [PhD 2011] and husband Ben moved to Flagstaff, Arizona in August 2010. Carrie is a faculty member at Northern Arizona University and recently received a promotion to Senior Lecturer. Carrie loves her position because she gets to focus on teaching without having research requirements. Each year she teaches Mineralogy plus five 120-student sections of Geologic Disasters. That's nearly 650 students per year! Since arriving at NAU, Carrie has been working on improving the department-wide Geologic Disasters curriculum, which recently obtained certification as a First Year Learning Initiative course. She also co-authored a new Geologic Disasters laboratory textbook focused on the geology and hazards of northern Arizona. Carrie is also involved with supervising undergraduate research projects related to volcanoes in northern Arizona.

Rebecca Carey [PhD 2008] has become a Senior Lecturer at the University of Tasmania.

Chris Conger [MS 2005]: I have been working at Sea Engineering, Inc. since 2011. I work on a range of projects including coastal design, coastal assessments, permitting, and diving. I feel very fortunate to be part of a local, small business and working with great folks. My wife Katie, who I met at UH, and I have two boys, Coltin (8) and Kade (9), who keep us busy and young.



Samantha Jacob [BS 2012; MS 2015]: I spent the last three years working as part of the Mars Science Laboratory mission. I am responsible for making GIS maps & assisting in the daily operations of the Curiosity rover. I graduated with my master's degree & I am currently working on publishing my thesis results this summer. I plan to continue working with the Curiosity rover as I move forward into a PhD program.



Alyson Joos [BS 2009]: This year has brought about some major changes in my working life. I became employed in July as a sales manager of high-end raw materials for the personal care and cosmetic industry by DKSH, a well-known Swiss company. The company is celebrating its 150th anniversary this year. As I write, I am currently attending the personal care industry's largest annual trade show; this year it's in Barcelona and expected to reach participation numbers of approx. 10,000.

Since this is the first time submitting to the newsletter, I don't believe it's been published that I received a Masters of Environmental Geology and Geohazards back in October of 2012 from the University of Oslo, Norway.

Aaron de Loach [BS 2010]: I am sailing as a Physical Properties Technician. The section of the lab I look over collects density, P-Wave velocities, spectral reflectance and magnetic susceptibility. The

data is mostly used to correlate between holes. This expedition is focused on the link between the formation of the Himalayas and the Monsoon, as well as erosional processes and climate. We are recovering sediments and basement rock from the Indus Fan.

Marc McGowan [MS 2004]: For the past four years I have been working in the Iron Ore division at BHP Billiton in the Pilbara region of northwest Australia. I primarily work on mine dewatering, pit slope depressurisation, and potable water supply projects. Effectively managing surplus water is an ever increasing aspect of the work our team deals with.



2014 was a busy year for our family. In January, my wife and I welcomed our daughter, Vivienne, into the world and in October we completed building a house. In September of this year we are expecting a baby boy.

Erin Miller [BS 2009] became Mrs. **Erin Nishimura** on December 21, 2012 and moved to California in 2013. She recently gave birth to a beautiful baby girl! Emmy Renae Nishimura, born 2/11/2015.



Emmy Renae Nishimura.

Lin Pope [ABD 1987]: She's been a Geology instructor at the University of Southern Mississippi since 1989.



We purchased a historic hotel in Pitkin Colorado called the Pitkin Hotel and I will be out there all summer running it. Bob and I have one more year before retiring so it was about a year early but we had the opportunity back in December so we jumped on it. The website is: www.pitkinhotel.com.

Craig Senter [BS 2008]: Professionally I am with the USGS Water Resource Division (will be 7 years as of June 2015). In 2011 I moved from the Pacific Islands Water Science Center (in Honolulu) to take a position as a Junior Hydrologist with the California Water Science Center in Redlands, CA.



Craig Senter measuring flow in one of the streams near Tacoma, WA.

There I worked as a lead in an ongoing water quality sampling project in the Mojave Desert as well as the Antelope Valley. This included the infamous Hinkley/PG&E hexavalent chromium contamination in the groundwater. In October of last year, I transferred to the Washington Water Science Center in Tacoma to be closer to family. I am currently working on a regional study of water quality monitoring in Puget Sound streams.

Personally I am overjoyed to announce that my wife gave birth to our first child, Graham Hideaki Senter, on February 21, 2015.



Mike giving an interview during a wildfire in Sequoia National Park.

Mike Theune [BS 2007]: This year, I transferred back to the National Park Service to Sequoia and Kings Canyon National Parks in the southern Sierra Nevada where I'm the Fire Information Officer. My job is to communicate with the public and media on the parks' wild and fire, prescribed fire, structure fire, and aviation programs. This makes it one of the most complex fire programs in the National Park System – especially as we look at conditions with the drought and climate change in the parks.

I was fortunate to be able to transfer with my wife, **Ashley Occhipinti [Meteorology 2008]** who is the lead ranger for the parks' main entrance station in Ash Mountain. We moved from northern Minnesota where we both worked on the Chippewa National Forest - I was their public affairs officer.

* * *

Take your group pictures at AGU or any other place where GG alumni meet and please send them to us.

Disclaimer: If you find any errors in the names and graduation years, we're very sorry. Please contact us we will fix them.

* * *

Field Trips



GG 399 students measuring stream flow.



GG 455 field trip to Nuuanu Reservoir.



GG 305 students start out urban.



GG 305 first day of mapping Hanuama Bay.



Here's what GG 305 looked like after a week and a half in the Mojave desert.



GG 305: Why are they always so happy to get to Death Valley?

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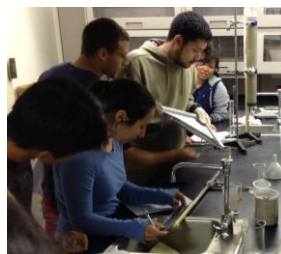
Learning in the Laboratory



GG 399 worked on verifying Darcy's Law.



GG 399 built an excellent Ghyben-Herzberg lens.



GG 455 Porosity Experiment

Remember When...

you held your first rock specimen in a GG class or took your first GG field trip?
you made your first map, learned about a useful isotope, or looked at a seismogram?
GG department became your academic home, a place of learning, with friends and colleagues?

Help others have that experience with a gift to the GG department. Your donation would provide funds to maintain and replace aging teaching infrastructure, support field excursions, and provide modern computing and audiovisual equipment for our classrooms and computer lab.

Please contribute today to the GG department fund at the University of Hawai'i Foundation and help make those *geo-dreams* come true for a new group of emerging geoscientists. Consider making a gift today, using this form or through the UH Foundation website (see below). *Thank You!*

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