WINTER 2010

Earth & Planetary TIMES

HARVARD UNIVERSITY DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Arctic haze over the North Slope, Brooks Range, Alaska.
Arctic Haze is a winter- and spring-time build-up of anthropogenic atmospheric pollution in the Arctic atmosphere that can persist for weeks.

PHOTOGRAPH BY CAMERON S. MCNAUGHTON

Analyzing Pollution in the Arctic Atmosphere

GEOS-Chem model helps quantify atmospheric composition

BY JENNY FISHER, FOURTH-YEAR GRADUATE STUDENT

For centuries, the remote, sparsely-populated Arctic has been considered one of the most pristine and unpolluted environments on Earth. Yet despite its distance from the world's major population centers, the region is adversely affected by a by-product of human activity: air pollution. Large amounts of soot, ozone, mercury, and other pollutants accumulate over the pole every winter and spring, when constant darkness and cold temperatures slow the atmosphere's natural removal processes. The resultant hazy Arctic skies have far-reaching implications for air quality, atmospheric chemistry, polar ecology, and global climate.

Quantifying the sources of Arctic pollution has been a problem of long-standing interest to the scientific community. While some pollutants are undoubtedly local (such as the oil fields of Alaska and the copper smelters of Russia), the scale of the pollution influence points to emissions transported from much larger sources in the industrialized countries of the northern mid-latitudes. Early studies in the 1970s and 1980s blamed industrial activity in Europe and the former USSR. Over the past 20 years, however, the global distribution of pollutants has changed dramatically, and more recent studies disagree as to which sources are responsible for the pollution.

A variety of data are available to study the Arctic atmosphere,

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FROM THE CHAIR JOHN H. SHAW

Welcome to the inaugural issue of *Earth & Planetary Times*,

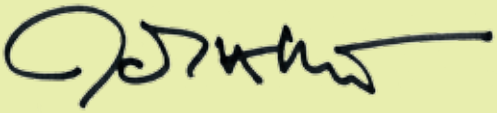
a newsletter dedicated to strengthening the community of scholars, students, staff, and alumni of Harvard University's Earth and Planetary Sciences (EPS) Department. You might ask why we initiated this effort in such trying financial times. Most of Harvard's press coverage these past months has focused on endowment losses. Our fine University, however, seems to be making a strong recovery, and the most important activities in EPS—improving our undergraduate and graduate programs, supporting our talented staff, growing our faculty, and pursuing inspired research—haven't missed a beat. Our newsletter is inspired by a desire to share these rewarding activities with you, and in the process to help build a stronger EPS community.

PHOTOGRAPH BY RYAN PETTERSON

Stop one, day three. After climbing a little over 2,000 feet from lake level, the undergraduate field trip troupe, led by John Shaw (center, back row in red polo shirt), poses for a group photo at the McConnell Thrust at Mt. Yamnuska. To see more photos visit http://structure.harvard.edu/RockiesPix2009.

As you will see in the articles and photographs that cover these pages, the past year has been one of great progress. We welcomed two new senior faculty members—Jerry X. Mitrovica and Ann Pearson—and two new assistant professors—Francis Macdonald and David Johnston. Ann was promoted from within, and represents the first female senior faculty member in Earth sciences over the long history of our University. Moreover, our faculty and scholars continue to pursue an ever-expanding range of research—seeking to understand the Earth's atmosphere and oceans, the workings of its inner core, mantle and crust, examining the origins of life, and exploring other planets. This diversity of interest reflects our charge as an "Earth and Planetary" department, one that is keenly interested in maintaining strength in geology while embracing other disciplines that are revolutionizing our field.

Much of this research aims to directly benefit our society—by addressing issues of climate change, pollution, energy, resources, and hazards. These topics serve as the greatest selling points for our undergraduate concentration, which has more than doubled in size over the past six years. To benefit these students, as well as those in our vibrant graduate program, we have worked hard to revise our curriculum and promote educational opportunities beyond the classroom. Recent student trips to Iceland, Hawaii, and the Canadian Rockies help broaden the horizons of our students, while building relationships that will hopefully extend beyond their time at Harvard. It is precisely these relationships that we hope to foster with you through this newsletter. So please read ahead, reminisce a bit, and enjoy. Also, please contact us if you would like to share your thoughts and stories with our community through future editions of *Earth & Planetary Times*.



Harry C. Dudley Professor of Structural & Economic Geology | Harvard College Professor

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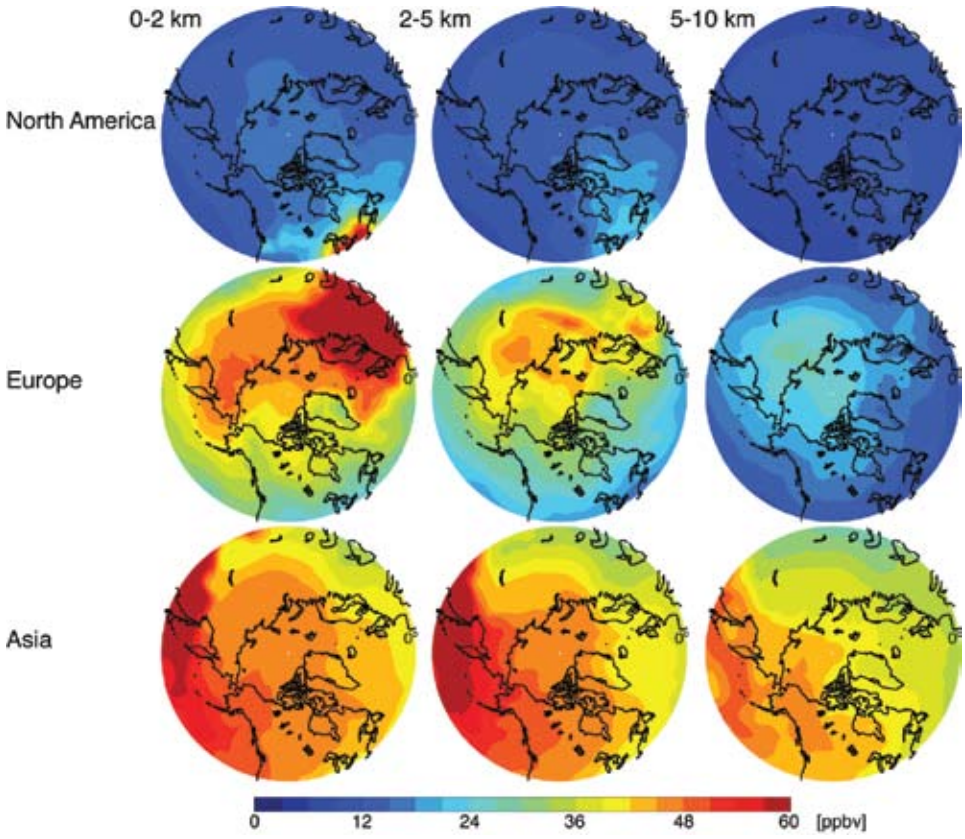


CHART COURTESY OF JENNY FISHER

Figure 1. Mean CO concentrations in different altitude bands for emissions from different regions as simulated by the GEOS-Chem model.

"Plumes of pollution aren't impossible to track if you know how to look for them." *~Jenny Fisher*

CONTINUED FROM PAGE 1 each with distinct advantages and disadvantages. Surface-based measurements provide long-term records but are limited to a few sites and to the lowest levels of the atmosphere. Aircraft campaigns provide enhanced vertical coverage but occur infrequently (every 5-10 years) and cover a limited spatial region. Satellites provide daily coverage of the polar region but the data are difficult to interpret and have yet to be tested in the Arctic. Individually these data provide only sparse snapshots of the polar region, but combined they form a more comprehensive picture. Unfortunately, they can't be compared directly due to differences in resolution, sampling location, and sampling frequency. In the Atmospheric Chemistry Modeling Group, we use a global three-dimensional chemical transport model (GEOS-Chem) to combine the complementary information available in these different datasets in order to provide quantitative constraints on the sources of Arctic pollution.

Plumes of pollution aren't impossible to track if you know how to look for them. We use carbon monoxide (CO) as an indicator of atmospheric pollution. CO is emitted by incomplete combustion—fossil fuel and biomass burning—and stays in the atmosphere for several months. This is long enough for a plume of CO to be tracked from a mid-latitude source to the Arctic but short enough that it doesn't get mixed into the background. Perhaps most importantly, CO is one of only a few pollutants that is measurable from space.

Last April, as part of the 4th International Polar Year, NASA and NOAA sponsored extensive aircraft campaigns, covering a swath from Alaska to Greenland to the North Pole and providing enough CO observations to perform a comparison with the CO modeled by GEOS-Chem. The data show that CO in the GEOS-Chem model is consistently lower than observations, indicating that our state-of-the-science estimates of CO emissions from fossil fuel burning are underestimated, particularly over Europe and Asia.

With improved estimates of CO emissions, we used the model to quantify the sources affecting Arctic pollution during spring 2008. Figure 1 shows the impact of fossil fuel burning in three regions (North America, Europe, and Asia) on CO pollution in the Arctic. Asian pollution is clearly dominant at all altitudes, although European pollution has some influence near the surface. In contrast, North American pollution has virtually no impact on the Arctic.

Satellite observations offer a longer-term perspective, providing context for the 2008 results. Data from NASA's Atmospheric InfraRed Sounder (AIRS) satellite instrument show that CO over Alaska in April 2008 was lower than average. We have found that AIRS observations of CO over Alaska are strongly correlated with the Ocean Niño Index, a measure of the strength of El Niño. Meteorological changes associated with El Niño enhance transport of Asian pollution to Alaska, while conditions associated with La Niña reduce this transport. This result suggests that the impact of Asian pollution on the Arctic, already dominant, could be even greater during a strong El Niño event.

Our work thus far has provided important constraints to understanding Arctic pollution—namely, the underestimation of fossil fuel sources, the dominance of Asian emissions and the importance of El Niño—but the picture is far from complete. While CO serves as a good indicator of overall pollution, other environmentally-important species are affected by different source distributions and atmospheric processes. Current research in our group is expanding on this work to better understand the sources and impacts of a variety of Arctic contaminants, including environmental toxins like mercury and climate-forcing pollutants like ozone, soot, and sulfate.

RYAN PETTERSON

Jenny's interest in air pollution developed while she was living in Pasadena, CA, where pollution haze was often thick enough to completely block the nearby San Gabriel mountains from sight.

References: Barrie, L. A.: Arctic air pollution: An overview of current knowledge, Atmos. Environ., 20, 643-663, 1986.; Law, K. S., and Stohl, A.: Arctic Air Pollution: Origins and Impacts, Science, 315, 1537, 2007; Quinn, P. K., Shaw, G., Andrews, E., Dutton, E. G., Ruoho-Airola, T., and Gong, S. L.: Arctic haze: current trends and knowledge gaps, Tellus B, 59, 99-114, 2007; Raatz, W. E., and Shaw, G. E.: Long-Range Tropospheric Transport of Pollution Aerosols into the Alaskan Arctic, J. Appl. Meteorol., 23, 1052-1064, 1984

Portrait of the Artist as a Young Geophysicist

Jerry Mitrovica chooses scientific creativity over playwriting

After graduating from the University of Toronto with a degree in engineering, new EPS professor, geophysicist Jerry X. Mitrovica spent a happy year trying his hand at playwriting. But although he "loved the lifestyle, wrote a lot and made a lot of friends," he decided that the writer's life was not his destiny and that he could be "just as creative in science."

He returned to school where he was strong, he says, mathematically. However, like so many people who ultimately become Earth scientists, Mitrovica says "I wanted to do something I could *see*. Then a professor at Toronto, a geophysicist, told me about a problem he was working on, a sea level problem."

The sea speaks to Mitrovica, deeply. Everyone at Harvard knows, of course, that there's a big ocean out there (usually somewhere east of where they are at any given moment) but that knowledge rarely enters their thoughts or affects their daily lives. But the sea exerts a powerful pull on Mitrovica; it reminds him of his Australian birthplace, and its proximity is one of the reasons he fell in love with Boston and ultimately decided to come to Harvard.

The ocean "is where I'm most comfortable," says Mitrovica. "The minute I see the water, I drop everything and start running toward the shore. I guess that's appropriate considering what I study."

And is that aforementioned sea-level problem what led Mitrovica from engineering and math to geophysics and Earth science? "Geologists knew for a long time," Mitrovica explains, "that every so often, for no known reason, large portions of individual continents would subside, and then there'd be a major sea level transgression. Then they'd just pop back up. The continents moved up and down like rafts, their edges lapped with water.

"We thought that maybe the forces that moved the tectonic plates around, that caused continental drift and sea-floor spreading, were also moving them up and down. So, with my colleagues, I ran some computer simulations, and we satisfied ourselves—and eventually everybody else—that there was another dimension, a vertical dimension, to plate tectonics."

Mitrovica and his colleagues' work on what they called vertical plate tectonics but would become more widely known as dynamic topography has been broadly accepted. "Now the idea of tilting continents is applied everywhere," says Mitrovica. For example, it was responsible for the region near present-day Moscow being under water 300 million years ago."

> *"I could use the tools of math and physics and solve problems I could see with my own eyes. Physicists work on more esoteric problems. Those problems are important, but I wanted something else—something more tangible."* ~Jerry Mitrovica

That work on dynamic topography taught Mitrovica several things, and sealed his commitment to geophysics and Earth science. He learned that he "could use the tools of math and physics and solve problems I could see with my own eyes. Physicists work on more esoteric problems. Those problems are important, but I wanted something else—something more tangible. So I thought I could solve these problems, hopefully with the help of bright and generous colleagues."

Today, the biggest problem going is climate change, and Mitrovica is again looking at sea levels, this time from the perspective of the Ice Age from which he says we're still emerging.

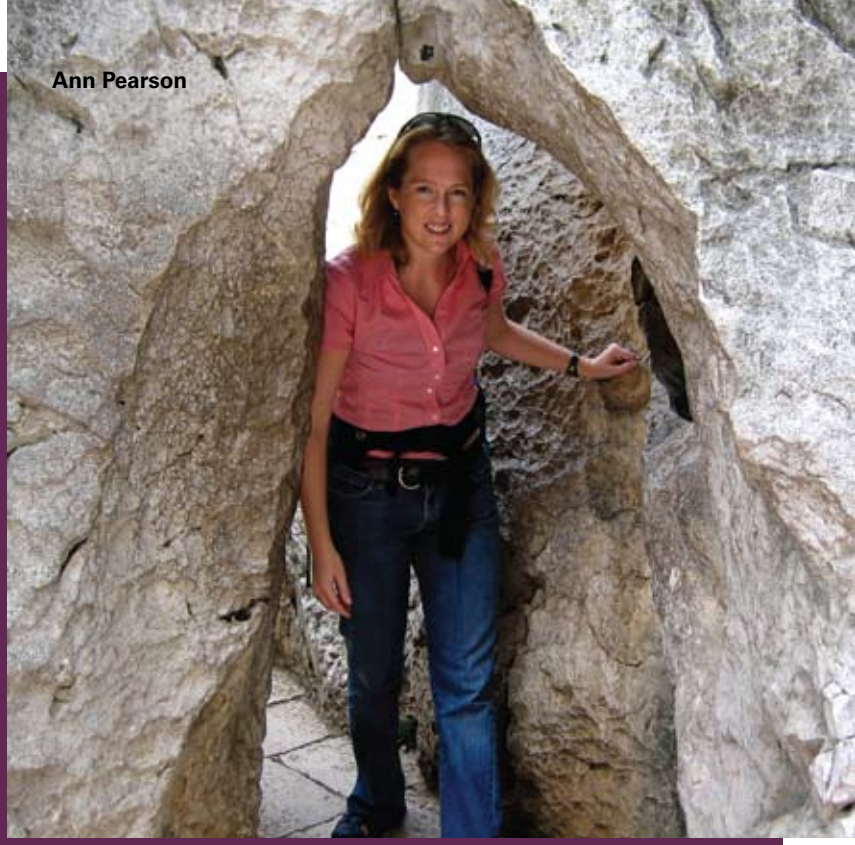
"If you rolled back the clock five or six years," Mitrovica says, "people might argue against climate change, saying that if the polar ice sheets were melting, sea levels should go up everywhere, as if you were dumping water into a bathtub. But they don't. Some places the level goes up; some places it goes down. And this was used by climate change skeptics to cast doubt on the model. But here's where physics helps: we were able to show in a series of papers that when ice sheets melt, sea levels are affected in a highly variable, even counterintuitive way.

"An ice sheet has mass," he explains. "Therefore, it exerts a gravitational pull, or tide, pulling the water toward it. When the ice sheet melts, you're certainly dumping water into the ocean, but you're also relaxing the tide because as the sheet shrinks, its gravitational force is reduced. So if the Greenland ice sheet should melt tomorrow, sea levels will *fall* in Scotland. The farther

Jerry Mitrovica

PHOTOGRAPH BY RYAN PETTERSON

INTO THE MUD WITH ANN PEARSON


Ann Pearson

COURTESY OF ANN PEARSON

When classes began this September, EPS had its very first tenured female faculty member. For Ann Pearson, the woman in question, this means…"not very much."

"I think," Pearson explains, "that it will mean more to me going forward. I'm from a generation of women who rarely felt different because of gender. I had plenty of women as peers. But when I was at college, I *would* notice when I met a more senior woman—especially a woman in her 50s or 60s—because that was so uncommon in the sciences."

Pearson, 37, has a way to go before hitting the Big 5-0, but she is now assured of being at EPS when she gets there, studying the interaction between the Earth and the life upon it, using chemistry, her primary discipline, and combining that with biology, oceanography, and geology.

Pearson's background is unusual even by the standards of Harvard's signature diversity. She grew up in the San Juan Islands of Washington State, "a beautiful place to vacation but very, very isolated." Raised on a small family farm, she went to a high school with a total of 100 students. She quit at age 16, becoming a high school drop-out "because there weren't any classes I wanted to take." In fact, Pearson did not get her high school diploma until she was already enrolled at Oberlin College, where she discovered chemistry, "the greatest thing that had happened to me academically, because there was always a correct answer; there was nothing ambiguous about it. I loved it."

But while contemplating her senior year at Oberlin, Pearson realized that she didn't want to go to graduate school in chemistry because she "didn't want to spend my life chained to a lab bench trying to make some obscure product that may or may not be useful to some pharmaceutical company some day."

Fortunately, during a summer internship at Bell Labs, Pearson realized she could use chemistry in combination with other disciplines to do work that was meaningful and useful without the commercial overlay that seemed to attach to chemistry.

Subsequently, Pearson earned her PhD in Marine Chemistry and Geochemistry at MIT in 2000 and at that time met EPS professor Dan Schrag (who was a friend of her post-doc advisor). This meeting helped bring her to EPS as Assistant Professor of Geochemistry in 2001.

At EPS, Pearson studies "biological signatures" to understand the ancient organisms that produced them and thereby illuminate the world in which they lived. "We study marine sediment," Pearson says.

"In other words, we study mud."

Through biochemical analysis of the mud, Pearson looks for those times when the Earth went through perturbations, specifically anoxic events during which the ocean's bottom lost oxygen. Those anoxic periods are associated with a warmer Earth, which is especially relevant during this age of global warming. This study brings Pearson into a natural collaboration with Associate Professor of Organismic and Evolutionary Biology Peter Girguis.

Indeed, Pearson particularly values collaboration and the community of scientists Harvard provides. She is looking forward to working with EPS's newest faculty members (see page 8, "Meet the New Guys"): Francis Macdonald, whose field work helps create a timeline in which Pearson can situate her samples, and David Johnston, whose work with sulfur isotopes can help her understand geochemical cycles that took place in the mud. As a senior professor, Pearson also accepts responsibility for her junior colleagues, seeing part of her job as making sure their experience at EPS—both in their research and teaching careers—is a positive one.

That's easy, says Pearson, because "I *like* my Harvard colleagues." And, given her somewhat isolated upbringing in the San Juan Islands, she, perhaps more than most, appreciates intellectual community.

»David Rosenbaum

you are from an ice sheet, the higher sea levels will rise.

"This turns the whole bloody problem around. Each ice sheet has its own signature in terms of its affect on sea levels, a fingerprint. Greenland's ice sheet will do this; Antarctica's will do that. We can try to decipher by looking at the pattern of sea level change *where* the water is coming from. By having a few data points (the more the better)—this is going up this way; this is going up that way—you could sit in the middle of the Pacific and infer from the data not just how much water is entering the ocean but where the water is coming from."

Now, says Mitrovica, "we'll further develop this idea of fingerprints; we'll try to understand which ice sheets are more unstable, and this will enable us better to understand the impact of climate change on the Earth system. For example, scientists are worried that the West Antarctic shelf—which acts as a sort of girdle on the main ice sheet—will break up. If it does, the ice sheet may collapse and sea levels will rise, on average, five meters. Well, that's true in a general sense, but that's the bathtub model. It turns out that the sea level on the eastern US coast will rise closer to *seven* meters, not

five. And that's important to know; knowing that can influence the thinking of scientists, the general public, and policy-makers. That's big."

Mitrovica admits that while most science is accomplished by focusing intensely, passionately, on small problems, with the sum of their solutions advancing general knowledge, he confesses that he's drawn to big problems, with big implications, and that's another reason he decided to come to Harvard and EPS.

"I was happy at Toronto," says Mitrovica, whose Albanian-born parents moved from Australia to Canada when he was 10. "I had great colleagues and I'm a Canadian patriot; I like hockey. But if I stayed at Toronto, I'd know pretty well what I'd be doing three, four, five years down the road, what problems I'd be working on. Here, I have no idea. And that's exciting. The difference here is that I get to talk to people who, in one conversation, can completely alter my view of things."

"Here," Mitrovica continues, "I sit next to a climatologist like Peter Huybers, an oceanographer like Eli Tziperman. I can talk to geophysicists like Rick O'Connell and Adam Dziewonski. Then, of course, there's Dan Schrag, who's a force, a superb climate scientist. And I get the sense that there's an interest here in addressing transformational issues and problems.

"Here, I sit between these two fields, the climate and the solid Earth. That's a fun place to be."

And if the West Antarctic ice sheet does melt away, Cambridge will be just that much closer to the sea Mitrovica loves.

»David Rosenbaum

Field (Trips) of Dreams

Annual field trips inspire, educate EPS concentrators

COURTESY OF GEORGE PLAVANSKY

Stop two, day one. Fourth-year graduate student Amanda Hughes explains fault imbrication to senior Trevor Petach at the McConnell Thrust at Barrier Lake.

Field work has long been considered a critical component of any serious study of Earth science. After all, there's nothing quite like seeing the real life version of a textbook topic.

Just ask an EPS concentrator. Tom Benson '09, for example, describes the trips as an "invaluable" way to create and enhance friendships while seeing real-world applications of the study of Earth science. "Learning about volcanic processes, as well as geothermal power generation on the field trip to the big island of Hawaii, was an incredible and practical experience for which I am eternally grateful."

Each year, for the last nine years, the Department of Earth and Planetary Sciences has offered its undergraduate concentrators the opportunity to attend a week-long excursion to some of America's most fascinating geological locations. Occurring just prior to the start of the fall term, the annual trips supply outdoor adventure, academic inspiration, and—perhaps most of all—peer bonding.

While plenty of other universities run field trips for their Earth sciences students, Harvard's EPS program stands out from the crowd by providing departmentally-funded trips every year to concentrators, from sophomores through seniors. Although each trip focuses on a particular subdiscipline, the result is an overall enthusiasm for earth sciences in general and a tight-knit departmental community.

"We felt these field trips would be an effective way to inspire students by showing them what we do as geologists, and also to provide an opportunity for students to interact with one another at the beginning of each academic term," says John Shaw, the department chair, who took 25+ concentrators to the Canadian Rockies in August.

The excursions rotate every three years, allowing students to participate multiple times without repeating a destination. In 2008, students hiked across volcanoes and rain forests in Hawaii. In 2007, concentrators spent a week on an oceanographic cruise, mapping the sea floor and analyzing currents off the California coast.

The department covers participant expenses, which average around $1,000 per student, using funds that are earmarked solely for field work. To keep costs down, the students camp in tents in the mountains, bunk in former military barracks in Hawaii and cook their own meals. Airline tickets comprise the biggest expense. Anywhere from 65 to 75 percent of the concentrators each year sign on for the trips. (Some students opt not to attend because of work commitments or other engagements.)

While EPS is fortunate to have several small endowment funds that are restricted to funding such field work, the department continues to rely upon the generosity of current alumni and other friends for contributions to fund its activities.

In 2000, the department decided to reinvigorate the program after a period of relative inactivity and make it a core element of the EPS concentration. Students

But Wait…There's More

The department's undergraduate concentrators aren't the only ones who are bonding with their peers while exploring magnificent outdoor terrains. Graduate EPS students also take advantage of the funding earmarked for field work in order to conduct research at various geological hotspots.

While faculty members lead the undergraduate field trips, it is the graduate students who develop, plan, and guide the trips for their peers. Students interested in leading a trip must write a proposal—explaining the academic merit and providing a detailed budget—to earn the approval of the Graduate Studies Committee and secure the necessary funding. The proposal process in and of itself serves as a teaching tool for the PhD candidates who, in all likelihood, will spend much of their careers chasing after grant money.

The graduate trips—there have been four in recent years—have been growing more elaborate. This year's visit to Iceland was, by all accounts, the most popular (36 graduate students participated) and the most ambitious to date. "Iceland exemplifies the geosciences in spectacular ways, catering to all Earth sciences disciplines with its volcanoes, glaciers and geysers," says Glenn Sterenborg, a fifth-year PhD student who co-led the August trip with fellow doctoral students John Crowley (G4) and Eric Kiser (G3). This year seemed a particularly good one to visit Iceland, where a faltering economy has resulted in lower prices.

Unlike the undergraduates, the participating graduate students must each develop a lecture to accompany one component of the trip. For example, first-year graduate student Scot Miller (AB '07) began the trip with a talk on Iceland's geophysical origin; G4 Jenny Fisher discussed air quality issues (see her article in this issue, page 1); during the visit to the glacial tongue at Solheimajokull G2 Eloise Marais's talk focused on glacial surges, and on the last day, day eight, G2 Kevin Wecht (AB '07) discussed the technology and efficiency of geothermal energy in Iceland.

"We argued that this year is the ideal time to visit Iceland," Sterenborg says. "We wanted to do something that was a little bit better than other trips, and Iceland offers a perfect example of things to study by connecting multiple Earth science disciplines. While our preparation for the trip certainly primed us for a magnificent experience, Iceland far exceeded our expectations in terms of beauty, diversity of landscape, and the shared adventure."

Graduate students take a moment to pose for a group portrait at the glacial lagoon Jökulsárlón.

KRISTIAN BERGEN

"Learning about volcanic processes, as well as geothermal power generation on the field trip to the big island of Hawaii, was an incredible and practical experience for which I am eternally grateful."

~Tom Benson '09

who had declared EPS as a concentration would be eligible to participate, giving some faculty pause: Would students sign on as EPS concentrators simply for a free trip and then drop the major upon return?

"We couldn't force students into indentured servitude—they could always switch out of the department after the trip," Shaw says. "But we have found that hasn't happened. Nobody has done that. Students are choosing this concentration for the right reasons. Participating in the field trip simply reinforces their decision to join the department."

In fact, the number of EPS concentrators has doubled since the field work program began. Nine years ago, the department had about 25 concentrators; today, that number hovers around 50. And the overall popularity of the department has soared among non-majors, too. Enthusiasm among what Shaw calls the department's "happy concentrators" seems to be infectious. Last year, for example, 400 undergraduates competed by lottery for a spot in a course on natural disasters that could only accommodate 140 students.

Sujoy Mukhopadhyay, an associate professor of geochemistry who leads the Hawaii trips, says students come away from the field work feeling a strong sense of departmental community and camaraderie. "These trips are integral to the learning process for students. You can read about something in a text book or you can read about it online," he says, "but to physically observe it in action is something very different, and that's why these trips are unique."

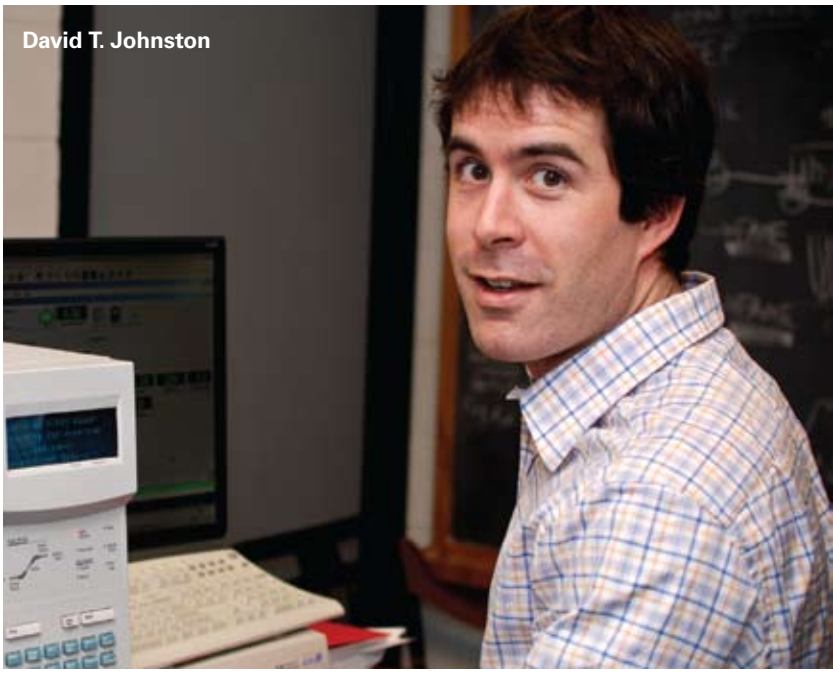
»Robin Estrin

Funding the Fieldwork

A large portion of the funds for these activities comes from an endowment established in 1907 in honor of Nathaniel Southgate Shaler, a legendary Harvard geology professor and paleontologist, as well as an accomplished poet. After his death in 1906, a group of students and friends established the Shaler Memorial Fund, which has supported numerous expeditions over the years. A second field work fund was created a half century later to honor noted Harvard geologist Reginald Daly, an early proponent of the concept of continental drift.

Meet the New Guys

Living la vida unlocal


David T. Johnston

Despite Harvard's tumultous times, the EPS Department has been privileged to welcome this September two new assistant professors. Say hello to:

Assistant Professor Francis A. Macdonald

"Field work," says Francis Macdonald, "is about going places people don't get to go and seeing things people don't get to see." And Macdonald's research certainly has taken him off the beaten track, from Australia's deserts to Mongolia's Gobi Desert, from Namibia to the Arctic to the Kalahari. ("I like deserts," says Macdonald. "There's not all that damn biology to cover up the rocks.")

The 30-year-old Macdonald grew up in Moscow, Idaho, and always has been happiest outdoors. After graduating from high school, he was invited by Maynard Miller of the University of Idaho's Glaciological and Arctic Sciences Institute to spend a summer on the Juneau ice fields helping Miller monitor the melting of the ice sheet. "It was pretty fun," says Macdonald of his teenaged adventure, "skiing around the glacier and setting off bombs."

Geophysics combined Macdonald's interest in science with his love of the outdoors and led him to undergraduate studies at Caltech where his advisor was Joe Kirschvink who was in turn a student of Gene Shoemaker. After Shoemaker died in a 1997 automobile crash in Australia, Macdonald accepted a Watson Fellowship in 2001 to go to Australia to finish Shoemaker's maps of circular structures and help define which structures were caused by meteor impact. On his own, living out of an old Land Cruiser, Macdonald gained self-confidence. "Through struggle, I realized I could formulate a problem, work on it, and come out with interesting science."


Francis A. Macdonald

It was his desire to work with Professor Paul Hoffman using field geology to address questions in Earth history that brought Macdonald to EPS as a graduate student in 2004. In July 2008 he was invited to join the EPS faculty.

"Geology is really experiential," says Macdonald. "It's cumulative. So it's a little intimidating to be a new guy, but I have a lot of support."

What excites Macdonald now is the possibility of telling stories about how the Earth evolved *without* index fossils. "It's difficult going back in time," he says. "We're looking at folded up rocks in mountain belts and we're so far back in time we don't know where these rocks and plates [originally] were." So Macdonald is looking at volcanic ash, and the "little time capsules" of uranium-containing zircon "which allow very precise measurement. The Precambrian was a time of great change in terms of tectonics, climate, ocean geochemistry, and biology, but we don't even know in relative terms when those changes occurred."

It's Macdonald's goal, working with other EPS scientists, to change that.

Assistant Professor David T. Johnston

David T. Johnston and Francis Macdonald have a lot in common, including a love of the outdoors and, more specifically, skiing. In fact, the 29-year-old Johnston, who at one time had hopes of skiing for the US Olympic alpine team, chose Bates College in Maine after graduating from high school in Lake Placid, New York (home of the 1980 Winter Olympics and the "miracle on ice") partly because "the skiing was so good." Although he never did become an Olympian, skiing came in handy when, as a philosophy major at Bates ("Philosophy provides me with a perspective I'm happy to have," says Johnston), he explored Adirondack Park in New York to write his BS thesis on the idea of reintroducing wolves to the park. (Although Johnston loved the romantic notion of returning wolves to their former range, the science didn't work; his study indicated that Adirondack Park wasn't large enough to support a genetically healthy lupine population.)

At Bates, Johnston hooked up with an organic geochemist and discovered that "that was a shoe that fit," and from Bates he went to the University of Maryland where he received his PhD in Geology in 2007.

At Maryland, Johnston developed a tool for analyzing and measuring sulfur isotopes in ancient rock and a way to use them as a bio-marker, thereby creating another lens through which to view the Precambrian and Neoproterazoic environments. For example, Johnston found that the amount of his sulfur isotopes in ancient ocean sediment was disproportionately large about a billion years before it should have been, "meaning that there was more oxygen in the atmosphere and different bacteria at that time than previously thought." So why, Johnston asks,

PHOTOGRAPHS BY RYAN PETTERSON

PROMOTIONS

In addition to hiring two new junior faculty (David Johnston and Francis Macdonald), one new senior faculty (Jerry Mitrovica), and promoting to tenure Ann Pearson, academic year 08-09 saw three promotions from within the ranks of our junior faculty.

COURTESY OF BRENDAN MEADE

Brendan Meade

Promoted to Associate Professor of Earth and Planetary Sciences, Brendan Meade's research focuses on problems of mechanics and evolution of the Earth's crust. His work aims to understand the distribution of motion and earthquake occurrence on an interacting system of faults, and to relate the deformation to the underlying larger scale plate motions that ultimately drive the system. Meade first came to the department in 2004 as a Daly Postdoctoral Fellow and joined the faculty in 2005 as an assistant professor. His current work addresses slow slip events on faults—which are essentially slow earthquakes that are in the boundary between earthquake faulting and slower deformation measured by geodesy. This work ties the abrupt seismic deformation to the slower processes associated with the steadier motion of tectonic plates, and also provides conditions for the occurrence of such slip events.

Sujoy Mukhopadhyay

When Sujoy Mukhopadhyay joined the faculty in 2003 as Assistant Professor of Geochemistry, he brought with him expertise in noble gas geochemistry, an area new to the department. The inert nature of the noble gases make them unique geochemical tracers for studying a variety of geologic processes including the formation of Earth's atmosphere, low temperature thermochronometry, exposure age dating, geochemical evolution of the Earth's mantle, and magma degassing. Since his arrival, Mukhopadhyay has built the first multi-collector noble gas mass spectrometer. As Associate Professor of Geochemistry, he will continue his research on understanding the feedback and linkages between processes operating within the deep Earth and processes operating on the Earth's surface.

JON CHASE/HARVARD NEWS OFFICE

COURTESY OF SARAH-STEWART MUKHOPADHYAY

Sarah Stewart-Mukhopadhyay

Promoted from Assistant Professor of Planetary Science to John L. Loeb Associate Professor of the Natural Sciences, Sarah Stewart-Mukhopadhyay joined the EPS faculty in 2003. She is an expert on hypervelocity impact events and uses experiments and numerical models to study the formation and evolution of planetary bodies. The foundation of her work is an experimental shock wave laboratory, which focuses on understanding how geologic materials respond to high pressures. Stewart-Mukhopadhyay is best known for the experimental study of H_2O ice under shock compression and calculating the volume of melted ice during impact cratering events.

"didn't animals come about earlier?"

Johnston came to Harvard in 2007 as a microbial sciences fellow and developed a project with Fisher Professor of Natural History Andy Knoll ("a great role model," says Johnston) to combine field work with microbiology—which is where what Johnston calls "a neat synergy" emerges between his work (to track quantitatively the relationship between microbial populations and the environment) and fellow skier Francis Macdonald's. Macdonald, says Johnston, is working to see how time is distributed, and Johnston is looking to see how elements are working as a function of that temporal distribution.

As he begins his first year as a member of the EPS faculty, Johnston is looking forward to teaching ("I always learn something from the kids," he says) and relishes and appreciates the support—both physical and intellectual—Harvard provides. "From the department level to the dean, the message is 'We want you to do the best you can do,'" says Johnston. "That mentality really permeates the culture here." »*David Rosenbaum*

Seismic Observatory Renamed to Honor Adam Dziewonski

Surprise tribute for EPS's geophysicist

More than 25 years ago, Professor Adam Dziewonski purchased a house that sits not much more than a stone's throw from the Harvard seismic station (in Harvard, Massachusetts) where he would spend much of his storied geologic career. Now, that very station bears his name.

To honor Dziewonski's recent retirement, the Department of Earth and Planetary Sciences renamed the observatory after the geophysicist best known for helping to demystify the deep interior of the Earth. There are more than 100 seismic stations as part of the Global Seismographic Network, the Harvard-Adam Dziewonski Observatory is the only one in the United States that is named after a living person.

The tribute came as a surprise to the professor, whose colleagues tried their best to keep it a secret until a few weeks before the dedication ceremony this past June. "I was very pleased, of course," Dziewonski says modestly. "It's a very nice gesture and I appreciate it very much."

Dziewonski transitioned from teaching faculty to research faculty on July 1, 2009 after an illustrious Harvard career that spanned nearly four decades. A popular fixture in the department and former department chair, Dziewonski has mentored hundreds of undergraduate and graduate students, many of whom are now successful seismologists and geologists.

Miaki Ishii is one of them. Dziewonski was one of her advisors when she was working toward her PhD (2003) in geophysics at Harvard. Now an assistant professor in the

COURTESY OF ADAM DZIEWONSKI

Adam Dziewonski and friend West Highland Terrier Sir K(ay) pose before the newly dedicated Harvard-Adam Dziewonski Observatory (Oak Ridge).

department, she oversaw the naming of the seismology station for him which was spearheaded by the department chair, John Shaw.

"We wanted to do something that would honor his contributions to science, his service to the community, and his dedication to the EPS department," says Shaw.

What better way to do so than by renaming the station that is regularly used in seismological studies and sits a mere 300 yards from his house? Dziewonski and his wife, Sybil, purchased their home in the town of Harvard in 1983. The observatory dated back to 1933 and got little use in the 1960s and '70s. But Dziewonski saw another chapter in the observatory's history was about to unfold.

In the early 1980s, one of Dziewonski's graduate students, Joe Steim (AB '78; PhD '86), began working at the observatory on a new type of seismograph system that could replace the traditional type of analog seismic instrumentation, which required many seismographs to record earthquake signals in different frequency ranges and of different amplitudes; his system would be called "very broad band" and would be able to record simultaneously signals that differ by a factor of one million times. An essential part of the system would be a very precise analog-to-digital converter (also called "digitizer,") which would have a dynamic range of more than 140 decibels. But before the system was fully developed, someone had to change the paper several times a week in the observatory so that they could visually monitor what was happening. With a house so close by, that someone became Dziewonski—a task he was happy to take on.

Dziewonski was excited by Steim's work, enthusiastically supporting him as he developed the data acquisition system (DAS). Steim's systems are now used all over the world, allowing scientists to monitor and analyze earthquakes in real time. Steim went on to found Quanterra, Inc., which was eventually acquired by Kinemetrics, a leader in seismic instrumentation. Steim and his company later contributed financially when the observatory was extensively renovated in 2007 and 2008. The Harvard station is still actively used as a testing and development site of new Earth-observing instruments.

Many credit Dziewonski with revolutionizing his field, and view him as a pioneer in several areas of geology. His work on free oscillations of the Earth, for example, led to the development of the Preliminary Reference Earth Model, or PREM, which broke new ground when Dziewonski and co-author Don Anderson published it in 1981. And his Centroid-Moment-Tensor Project catalogued more than 30 years of earthquake data, becoming one of the essential research tools for seismologists and for hazard mitigation organizations.

The 72-year-old has no plans to slow down his research as he begins the next stage of his career. "We still don't understand how the Earth works dynamically," he says. "My current view is that everybody is wrong and that the key to understanding how the Earth works lies very deep inside it. What happens 2,000 miles inside the Earth dictates the behavior of the surface."

His colleagues expect Dziewonski will continue to influence the field of seismology and Earth sciences for a long time to come.

»*Robin Estrin*

ULTIMATELY, EPS WINS HEARTS NOT FRISBEE

In anticipation of the October 16 EPS vs. Physics Ultimate Frisbee Challenge high-spirited (though misguided) physics concentrators surreptitiously hung a banner from Hoffman Lab's 4th floor balcony proclaiming "Physics Rocks." In response (and under the cover of darkness) EPS concentrators deposited a collection of rocks in the new Physics Student Lounge along with their own banner validating "EPS Rocks." (See photo at right.) Alas, game day proved to be unseasonably cold and rainy and EPS turnout was not what it might have been. Only three EPS concentrators showed up—four short of the required seven for a full team. EPS concentrator Renata Cummins '11 takes a rather positive view about the whole matter, "I have to admit that physics turned out far more people for the Frisbee game than I ever would have expected, given that the president of the Physics Society himself said that *'the only running physics students ever do is to Jefferson to turn in their problem sets.'* I take this outpouring of desire to crush EPS as evidence of how incredibly jealous they are of all our awesome field trips. We ♥ you, EPS department!!"

The covert EPS ambassadors are from left to right Peter Hedman '10, Jenny Middleton '10, Caitlin Rotman '10, Renata Cummins '11, Su Gao '10, and Trevor Petach '10.

Around *the* DEPARTMENT

Faculty

Paul Hoffman, *emeritus* Sturgis Hooper Professor of Geology, Harvard, paulfhoffmanATyahoo.com: received the 2009 Career Contributions Award from the Structural Geology and Tectonics Division of the Geological Society of America at their Annual Meeting in Portland, OR.

Peter Huybers, Assistant Professor of Earth and Planetary Sciences, phuybersATfas.harvard.edu, http://www.people.fas.harvard.edu/~phuybers/: writes, "This semester I was fortunate to be awarded an AGU Macelwane medal, Packard Foundation fellowship, and MacArthur Foundation prize—and now to put this good fortune to good use."

Miaki Ishii, PhD '03, Assistant Professor of Earth and Planetary Sciences, http://www.seismology.harvard.edu/~ishii/index.html: received the 2009 Macelwane medal from AGU.

Sarah Stewart-Mukhopadhyay, '95, John L. Loeb Associate Professor of the Natural Sciences: is the 2009 recipient of the Harold C. Urey Prize, awarded to an outstanding young planetary scientist by the American Astronomical Society's Division for Planetary Sciences. More information at http://www.fas.harvard.edu/~planets/sstewart.

Steven C. Wofsy, Abbott Lawrence Rotch Professor of Atmospheric and Environmental Chemistry, wofsyATfas.harvard.edu, http://harvardforest.fas.harvard.edu/profiles/wofsy.html: is currently a co-leader in the "HIAPER Pole-to-Pole Observations (HIPPO) of Carbon Cycle and Greenhouse Gases Study." This program will provide the first comprehensive global survey of atmospheric trace gases, covering the full troposphere in all seasons and multiple years. To learn more about this project visit: http://hippo.ucar.edu.

Post-doctoral & Research Staff

Carl Tape, Visiting Postdoctoral Fellow, carltapeATfas.harvard.edu, http://www.people.fas.harvard.edu/~carltape/: I began my NSF Postdoctoral Fellowship in May. My project (collaborators John Shaw and Andreas Plesch) aims to construct a 3D model of the Great Valley sedimentary basin in California, and to test and improve the model using seismic wavefield simulations. We are using Harvard's FAS "Odyssey" cluster to run these simulations.

Giampiero Iaffaldano, Reginald Daly Postodoctoral Fellow, iaffaldanoATgmail.com, http://www.people.fas.harvard.edu/~iaffald/index.html: I got married in Italy the 7th of December, and my new wife Anna and I moved to Canberra where I have been appointed as faculty at the Research School of Earth Sciences and ANU beginning February 2010.

Graduate Students

Four students received their doctoral degree this November: **Meytal Higgins,** PhD '09, *Reconstructing marine productivity using compound-specific nitrogen isotopes*; **David Jones,** PhD '09, *Stable isotopes in Neoproterozoic and early Paleozoic Earth history: correlation and climate*; **Roiy Sayag,** PhD '09, *Dynamics and spatiotemporal variability of ice streams*; and **Lin Zhang,** PhD '09, *Application of satellite observations and adjoint inverse modeling to intercontinental transport of ozone pollution.*

Phoebe Cohen, G6: Phoebe's research (she works in Andy Knoll's lab) offers a reinterpretation of microfossils from the time just before the Cambrian Explosion and was featured in both *The Economist* and *Harvard Gazette*: http://www.economist.com/sciencetechnology/displayStory.cfm?story_id=13437713 and the http://news.harvard.edu/gazette/story/2009/04/lighting-the-fuse-for-the-cambrian-explosion/

Amanda Hughes G4 and **Eric Kiser** G3: will be tying the knot next fall.

Allan R. Robinson, AB '54 mcl, AM '56, PhD '59, who was the Gordon McKay Professor of Geophysical Fluid Dynamics, Emeritus, at the Harvard School of Engineering and Applied Sciences and the Department of Earth and Planetary Sciences passed away unexpectedly at the age of 77 on September 25, 2009.

He was a pioneer in theoretical and numerical ocean modeling who made major contributions to fundamental physical and interdisciplinary ocean science and dynamics. Robinson was well-known as a consummate mentor and teacher. Many of his nearly 30 PhD students and 25 postdoctoral fellows now hold leadership positions in the ocean scientific community. *A memorial service will be held in the spring.*

TABLE TALK

In many ways, the fourth floor of Hoffman Labs is the hub of the department. With coffee available 24/7, cookies served daily at 3:00, and pizza delivered at 5:00 on Fridays, the Student Lounge with its eleven-foot-long oak table serves as a gathering spot for faculty, students, and staff throughout the day. The friendly and collaborative nature of the department often makes for interesting conversations, snippets of which are captured below.

"Does it burn up diamonds? That seems like an obvious one."

"I need to scale the size of the transient crater in order to measure the impact velocity."

"He was modeled on Count Dracula but he's known as Count von Count."

"Golden Oreos are really good as long as you can get out of your head that they're not Oreos."

"I am always skeptical when someone makes a presentation that's too good to be true."

"We enjoyed being Vikings last year."
"I enjoyed you being Vikings."

"Any mineral separation is time consuming."

"We decided that geologists should take over the South."

Alumni NOTES

Graduate

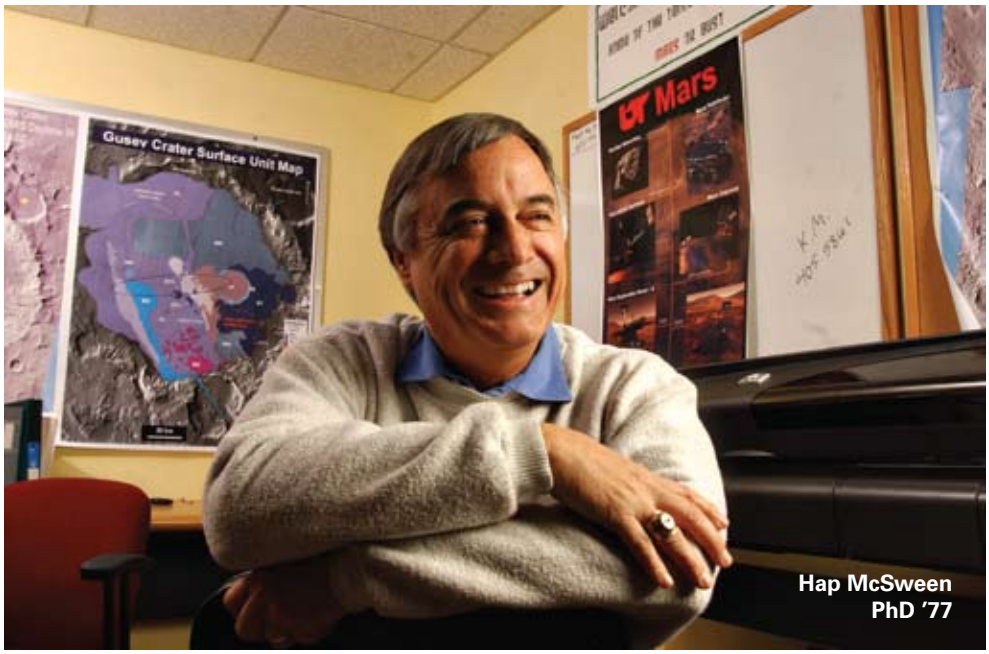
Olav Slaymaker, AM '63, olavsATinterchange.ubc.ca: After receiving my AM in Geology at Harvard in 1963, I proceeded to a PhD in Geomorphology at Cambridge (1968). From 1968-2004 I was on the faculty of the Department of Geography at the University of British Columbia in Vancouver, and am now Professor Emeritus at UBC. In 2005, I was awarded a DSc *honoris causa* by the University of Wales.

Bikash C. Raymahashay, PhD '67, bcrATiitk.ac.in: After completing my PhD with Bob Garrels, I joined Dick Holland at Princeton as a Research Associate. When I returned to India, I had a brief post-doctoral assignment at the Indian Institute of Science, Bangalore before joining the faculty at the Indian Institute of Technology, Kanpur. I retired as Professor of Geology and continued as an Emeritus Fellow until 2004. I have now settled in a suburb of Delhi and spend my time interacting with industry and academic institutes on environmental issues.

Jeff Warner, PhD '67, PatnJeffATKeyway.net, www.Keyway.net/~PatnJeff: I am retired for 10 years and still living in Los Angeles. I am now a peace activist, focused mostly on the Israeli-Palestinian conflict. If you think the battle for plate tectonics was hard in the 1960s, try working on peace and human rights.

Floyd W. McCoy, PhD '74, fmccoyAThawaii.edu, http://www.wcc.hawaii.edu/facstaff/mccoy-f: I got my PhD under Ray Siever. I am a professor at the University of Hawaii. Current efforts are creating the field of geoarchaeology—the combination of geosciences and archaeological sciences—via research focusing on the Late Bronze Age eruption of Santorini (Thera) in Greece, and the effects/consequences of that eruption on Aegean cultures and cultural change. Additional research programs are in Hawaii looking at sedimentary deposits from tsunami(s) and mega-tsunami(s), evolution of black sand beaches, and Hawaiian geoarchaeology.

"If you think the battle for plate tectonics was hard in the 1960s, try working on peace and human rights."
~Jeff Warner, PhD '67



Hap McSween PhD '77

COURTESY OF HAP MCSWEEN

Harry (Hap) McSween, PhD '77: has been named Chancellor's Professor at the University of Tennessee. Hap has spent his career working on meteorites, and is presently a co-investigator of three NASA spacecraft missions. He also serves as editor of the journal *Elements* and has just completed a textbook on cosmochemistry, to be published by Cambridge Press in 2010.

Mildred A. (Milly) Powell, PhD '82, milly.powellATgmail.com: I more or less gave up on geology during the oil bust (I was teaching in Pueblo, CO at that time), and eventually moved to Denver and switched to water resources GIS (Geographic Information Systems). I retired from Denver Water last year after 10 years of service, and am now doing contract work for the Colorado Division of Water Resources helping with stewardship for the National Hydrography Dataset.

Denise L. Mauzerall PhD '96, mauzeralATprinceton.edu, http://www.princeton.edu/~mauzeral/: is an Associate Professor of Environmental Engineering and International Affairs in the Department of Civil and Environmental Engineering and the Woodrow Wilson School of Public and International Affairs at Princeton. The objective of her research group is to utilize science to inform the development of far-sighted air quality policy.

Jie (Jackie) Li, PhD '98, jackieliATillinois.edu, http://www.geology.uiuc.edu/people/jackieli/index.html: was in the Department of Geology, University of Illinois, Urbana and in January 2010 moved to the University of Michigan. Jackie studies Earth and planetary materials under high pressures and high temperatures, using multi-anvil apparatus, diamond-anvil cells, micro-analytical instruments, and synchrotron radiation facilities. She is interested in the origin and evolution of terrestrial planets, terrestrial-like moons and asteroids in the solar system.

Bogdan Kustowski, PhD '07, kustowskiATpost.harvard.edu: As of 2009, I am still working as a Research Geophysicist in Geophysics R&D at Chevron, San Ramon, CA.

Noelle Eckley Selin PhD '07, selinATMIT.EDU, http://web.mit.edu/selin/www/: After completing my PhD, I started as a postdoc at MIT's Joint Program on the Science and Policy of Global Change. As a postdoc and then a research scientist at MIT, my research explored the impacts of climate change and air pollution. In January 2010, I started a faculty position at MIT in the Engineering Systems Division; I also have a joint appointment in MIT's Earth, Atmospheric

and Planetary Sciences Department. My research on the air pollution, health and economic impacts of global change policy and future technologies was recently awarded a grant from the US EPA STAR program.

Victor Tsai, PhD '09, vtsaiATpost.harvard.edu: I moved to Golden, CO in October 2009, where I have started as a Mendenhall Postdoc Fellow with the Geologic Hazards Team of the US Geological Survey. No research news yet, but I have settled in nicely here.

Undergraduate

Art Boucot,'48, PhD '53, boucotaATscience.oregonstate.edu: I am still alive and reasonably active at the fossil game.

Phineas Sprague, Jr. '72, phinATportlandyacht.com: After graduation, I worked for the State of Maine as a principal geologist identifying potential glacial deposits of clean sand for DOT construction projects. Later, I bought a schooner with three friends and had a four-year geology field trip. When I returned I worked at a specialty steel manufacturing. After Three Mile Island the company went out of business and I went back to school and received an MBA. During my MBA I started working on boats and now run a boat yard in Portland, ME. I am married with three grown-up kids.

Dave Nolan, '90 (physics), PhD '96, dnolanATrsmas.miami.edu: After leaving Harvard, I had research positions at the Lawrence Berkeley National Laboratory, Colorado State, and the Geophysical Fluid Dynamics Laboratory. In 2002 I became a faculty member at the Rosenstiel School of Marine and Atmospheric Science at the University of Miami, where I have been Research Assistant Professor, Assistant Professor, and now Associate Professor. I have a research group of one scientist and three graduate students. We mostly work on hurricane dynamics and some other topics in tropical meteorology.

Dan Goldner '91, goldnerATpost.harvard.edu: after graduating from Harvard earned a PhD. in physical oceanography in the MIT/WHOI Joint Program and then spent 10 years applying simulation and data assimilation techniques to management problems in industry and government. He recently returned to his first love, teaching, as a high school mathematics teacher in the Boston Public Schools. He gives his students the same advice his undergraduate advisor, Allan Robinson, gave him: "Do your homework."

Joshua Comenetz, '92, joshua.comenetzATgmail.com: I work as Chief in the Geographic Studies Branch of the Population Division, an international area of the US Census Bureau. Previously I was a geography professor at the University of Florida.

(Charles) Michael O'Connor '93, charmiocATyahoo.com: After graduating, I worked in Boise, ID for a year and then continued my education in Reading, England where I earned a master's degree in weather, climate and modeling. It's also

Dan Goldner '91 gives his students the same advice his undergraduate advisor, Allan Robinson, gave him: "Do your homework."

where I met my (Greek) wife. I've been working with the Environmental Services Department of the Athens International Airport since 2002, focusing on issues of local air quality and climate change. We have two girls, 4- and 7-years old. I would be happy to speak/meet with any pending or recent graduates about job opportunities, as limited as they may be, in our field in Greece.

Mark Potosnak '94, markATpotosnak.net: Since the fall of 2008, I've been an assistant professor at DePaul University in Chicago. Earlier this year, I bought a home in Evanston, and moved in with my wife Christie

CAITLIN BERGIN '06

I moved to Anchorage, AK a month after graduation and couldn't be happier here. For the past two years I've been working for Hoefler Consulting Group, an environmental consulting group in Anchorage. I started out doing Air Quality Monitoring and Air Permitting and Compliance for a number of the oil fields and mines in AK and have spent most of the last year developing an environmental compliance system for BP's North Slope Facilities which I continue to manage. I'm tentatively planning to pursue a degree in Civil and Environmental Engineering starting in fall 2010.

berginATpost.harvard.edu

COURTESY OF CAITLIN BERGIN

Since moving to Alaska Caitlin has tried to take advantage of its bountiful offerings: kayaking, cross country skiing, and kissing as many fish as possible.

Klimas and my daughter Elizabeth.

Suzanne M. Brown, '95, suzanne_brown_ab95ATpost.harvard.edu: After graduation, I talked my way into a position as a gold exploration geologist in Indonesia. That lasted two years, until the Asian bubble burst, at which time I pursued a PhD at the University of Western Australia. I learned a lot about economic geology but also that WA was a beautiful place to live. That led to a post-PhD shift to becoming a consultant in environmental science. I keep looking for an opportunity to get to Antarctica for a field season, if anyone has an environmental project that needs staffing!

Lisa (Wheeler) Wolfe '95, lisamwolfeAT-gmail.com: I was an undergraduate in the EPS department from 1986-1995. My serpentine path to the AB degree left me well qualified for an analytical role for several years as a management consultant with small and large companies across the US. I currently use my degree most frequently to help my two grade school daughters with their homework that often seems to resemble my introductory college science courses. When the "but why?" questions exceed my patience I refer them to their chemical engineer dad, who has put up with me for the last 12 years.

Arlene Fiore '97, PhD '03, Arlene.FioreAT-noaa.gov: I'm a research scientist at NOAA GFDL (that's National Oceanic and Atmospheric Administration Geophysical Fluid Dynamics Laboratory), a climate modeling lab. My research explores connections between air pollution, climate, and global atmospheric composition. On the home front, we've recently welcomed Serena (May 8, 2009) to our family, who loves giggling with her big sister Clarissa (age 2).

COURTESY OF DAVID OLESH

David Olesh '06 (top left) examining something earthy with his students at Teatown Lake Reservation in Ossining, NY.

Kalon Morris '98-'99, kmorrisAT-post.harvard.edu: is currently Professor of Geology/Oceanography at Saddleback College in Southern California. He just bought a new home in Oceanside, CA with his wife Jessica Morris.

Leslie Hsu, '00, hsu.leslieATgmail.com: After graduate studies at University of Arizona in Tucson and University of California, Berkeley, I will be starting a postdoc at UC Santa Cruz in 2010. My subfields are geomorphology and Earth surface processes, mixed with a bit of active tectonics.

Mark Little '01, mglittleATpost.harvard.edu: completed a PhD in geochemistry in 2008 from Rice University, and is currently working for the House Committee on Foreign Affairs as the 2009-2010 AAAS/USGS/GSA Congressional Science Fellow.

William Pomerantz '02, WilliamATxprize.org: William serves as the Senior Director of Space Prizes for the X PRIZE Foundation,

COURTESY OF FRANCES MOORE

FRANCES MOORE '06

I'm in my final year of Yale's Masters of Environmental Science program. My thesis studies the construction of adaptation policy in the international climate negotiations for which I've been attending and interviewing participants at the UNFCCC meetings and at the December Copenhagen negotiations. I also work on policy options for incorporating short-lived greenhouse gases into climate change policy and am organizing a workshop in the spring for the Yale Climate and Energy Institute. This year I was awarded an NSF Graduate Research Fellowship and a Switzer Foundation Fellowship.

fmoore125ATgmail.com

Frances Moore (far left) during her trip in the summer of 2008 to Tajikistan.

Photo of a wind farm located near Arlington, Oregon along the Columbia River Gorge taken by Jeremy Tchou '08 for his job at Garrad Hassan America, a renewable energy consultant in Portland, OR. Each turbine is over 120 m tall and is capable of producing 2.1MW.

COURTESY OF JEREMY TCHOU

where he manages all of the Foundation's space activities, including the Google Lunar X PRIZE. William also works as coach for the Zero Gravity Corporation, joining passengers in weightlessness on parabolic flights, and serves on the Board of Trustees for the Students for the Exploration and Development of Space.

Katherine Thompson '05, kjt2111ATcolumbia.edu: I took time off to add archaeology to my EPS skill-set in a master's program for geoarchaeology at the Vrije Universiteit Amsterdam. For many years, though, I've been interested in the human side of natural disasters like earthquakes, volcanic eruptions, and hurricanes. I'm now a doctoral student in Columbia's Psychology Department, studying risk perception and the ways experience, memory, emotion, and knowledge interact in the context of natural disasters. My goal is to do work that can be applied to help improve mitigation and prevention efforts.

Alvin Hough, '06, alvinhoughjrATgmail.com: A year after leaving Harvard I went to Georgia Tech in 2007 for a Master's in Meteorology. Sadly, that's just about when the economy went belly up, and jobs were hard to come by. So I put meteorology temporarily on the back burner. I moved to NYC last January and had been doing a wide range of part-time jobs, from playing piano for Broadway auditions to doing GMAT tutoring with a new start-up company (Knewton, Inc.). I just caught a huge break: I am now the keyboardist/associate conductor for the national tour of *Dreamgirls*.

David Olesh '06, david.oleshATgmail.com: I am currently living and working in New York City as an Earth science teacher at Automotive High School, a vocational public high school in Brooklyn, NY. This newsletter comes to me at an opportune time. Having just completed a master's degree in education I am now looking into grad schools for geology. I would love to reconnect with the EPS department as I continue towards the next step in my career.

Jonathan Sasmor '07

COURTESY OF JONATHAN SASMOR

Jason Munster, '07, jmunsterATseas.harvard.edu: I spent a year in finance and am now happily back at Harvard in Jim Anderson's group as a research assistant.

"I just caught a huge break: I am now the keyboardist/associate conductor for the national tour of Dreamgirls.*"*

~Alvin Hough, '06

Jonathan Sasmor, '07, jonathan.sasmorATgmail.com: recently completed *Culture of Kindness* a book about sustainability and religion. He presently lives in New York City.

Laura Larsen-Strecker '08, larsenstreckerATgmail.com: I currently live in Princeton, NJ to train and row with the US National team. I competed in the women's eight and the World Championships this summer, winning gold! It has been an unbelievable experience and I am exceptionally fortunate to be working as a research assistant for a couple of Princeton geoscientists, Dr. Simons and Dr. Sigman.

Daniel Stolper '08, dstolperATgmail.com: I have just finished my Fulbright in Don Canfield's lab in Denmark and am back to the grind as a first-year graduate student at Caltech.

Jeremy Tchou '08, jeremy.tchouATgmail.com: I just finished my master's degree at Stanford in the atmosphere/energy program and I am now working in Portland, OR at Garrad Hassan America, a renewable energy consultant.

Firth Mceachern '09, fmmceachATfas.harvard.edu: An EPS newsletter—what a great idea! I shall provide news if and when I've done something noteworthy.

Tidings

EPS is always pleased to hear from our alumni and friends. Send us your comments or news to: **epsnewsletter@eps.harvard.edu**. So that we may print your notes and photographs, please include with your submission:

1) your affiliation and year; and
2) the following statement:
I give consent for display of the note, my email address and/or web-link and any associated photo which may or may not appear in print and electronic version.

EPS Connections

Networking
Crimson Compass is an online career networking service available to students and alumni interested in learning about career and/or internship opportunities. There are currently over 15,000 alumni volunteering to share their professional experiences and expertise with students and other alumni. We would like to encourage all EPS graduates to become a part of the Crimson Compass network. To learn more about how to find an advisor or become an advisor visit http://post.harvard.edu.

Financial
EPS undergraduate and graduate programs have grown substantially in recent years, in part due to society's growing interest in energy and climate but also reinforced by our efforts to maintain strong foundational programs in geology, geophysics, geochemistry, and atmospheric and oceanographic sciences. Our goal is to continue to enhance these educational programs and expand our research in ways that will lead to exciting discoveries that benefit society.

If you are able and interested in making a financial contribution to EPS please send a check made payable to Harvard University, with a note indicating that is for the Department of Earth and Planetary Sciences to:

Department of Earth and Planetary Sciences
Hoffman Labs, Attention Krista Lester
20 Oxford Street
Cambridge, MA 02138

STUMP THE SCHOLAR

GARBAGE PATCH PUZZLE

Submitted by the EPS Climate Dynamics Group

If you plan to sail across the Pacific anytime soon, you may want to avoid the area east of Japan (roughly 35-40N, 150-170E). The problem isn't sharks. It's plastic. This is the location of the "Great Pacific garbage patch." We are talking over 300,000 floating pieces of plastic per squared km.

Your challenge: Explain why it's there. Your research tools: A cup of tea, made using old-fashioned tea leaves, not those nouveau instant tea bags. Stir, watch, think, and explain.

For some related resources, check out the following links:
http://en.wikipedia.org/wiki/Great_Pacific_Garbage_Patch
http://www.wikihow.com/Make-Tea
http://www-paoc.mit.edu/labweb/lab9/gfd_9.htm
http://swfsc.noaa.gov/publications/TM/SWFSC/NOAA-TM-NMFS-SWFSC-154_P247.PDF

Submit your answer to EPSNewletterATeps.harvard.edu. Winners will be selected by the time-tested method of placing all correct answers in a hat and with closed eyes the editor will draw five names. Winners will receive an EPS mug and the honor of having their name listed in the next issue of *Earth & Planetary Times* along with the correct answer, of course.

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