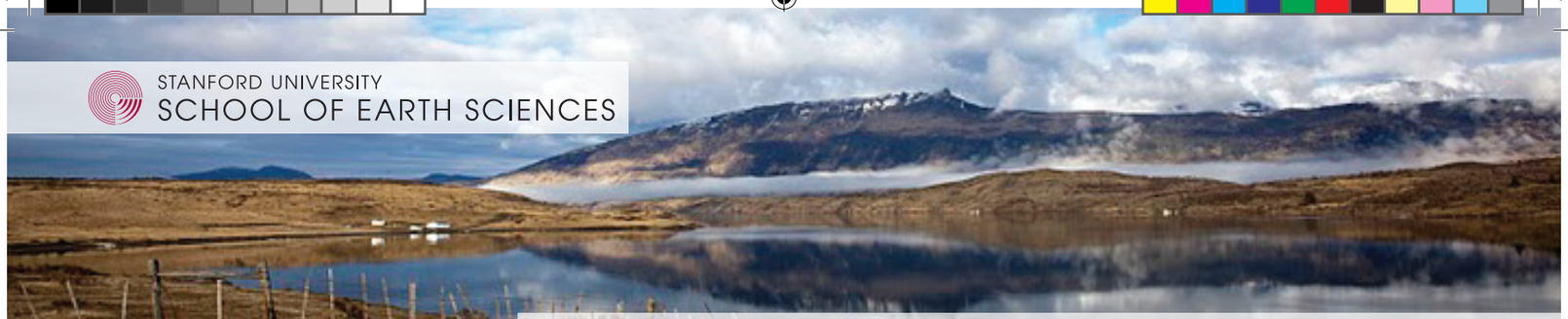
STANFORD UNIVERSITY
SCHOOL OF EARTH SCIENCES



Fall 2010

The Earth Scientist

Save the Date

Join the Stanford School of Earth Sciences for the following events:

OCTOBER 18, 2010
Alumni reception at SEG in Denver
5:30 – 7:30 pm
Hyatt Regency, Capitol 4
650 – 15th Street

OCTOBER 22, 2010
Earth Sciences Undergraduate Student Research Presentations
12:30 – 3:00 pm
Mitchell Building

Reunion Homecoming Alumni BBQ
4:00 – 6:00 pm
Mitchell Building

NOVEMBER 1, 2010
Alumni reception at GSA in Denver
5:00 – 7:30 pm
Hyatt Regency, Centennial Ballroom H
650 – 15th Street

DECEMBER 14, 2010
Alumni reception at AGU in
San Francisco (time and location TBD)

FEBRUARY 17, 2011
Alumni reception at NAPE in Houston
5:00 – 6:30 pm
Hilton Americas, Meeting Room 230
1600 Lamar

APRIL 12, 2011
Alumni reception at AAPG in Houston
(time and location TBD)

Registration at conferences is not required to attend the alumni receptions, and all are welcome at the Reunion Homecoming Alumni BBQ.

Above, top: Winter scene near Puerto Prat, chile, Robert B. Dunbar. Above, right: Julie Kennedy, senior lecturer and associate director of the Earth Systems Program, and Larry Diamond, senior fellow at Hoover and FSI, are the new faculty directors of Stanford's Haas Center.

Julie Kennedy named one of two new faculty directors of the Haas Center

by Elaine C. Ray, *Stanford Report*

Julie Kennedy and Larry Diamond have been named faculty directors of the Haas Center for Public Service at Stanford. Kennedy is a senior lecturer and associate director of the Earth Systems Program. She also holds senior lecturer positions in the Woods Institute for the Environment and in the Environmental Earth Systems Science Department. Diamond is a senior fellow at the Hoover Institution and at the Freeman Spogli Institute for International Studies (FSI).

Kennedy also serves on the FSI-Haas International Public Service Advisory Committee. As a senior lecturer in the Earth Systems Program, she specializes in interdisciplinary environmental education with emphasis on curriculum development, interdisciplinary problem analysis, and effective communication to expert and non-expert audiences.

Kennedy earned her bachelor's degree in geology from the University of California-Davis and her doctoral degree in geology from Stanford. She was promoted to senior lecturer in the Earth Systems Program in 1998 and became its associate director in 2001.

She has served as a senior lecturer at the Woods Institute for the Environment since 2005 and in the Environmental Earth Systems Science Department since 2007. Kennedy has received the School of Earth Sciences Excellence in Teaching Award twice, in 1998 and in 2006, and the Dinkelspiel Award in 2002. Kennedy was named a Landreth Family University Fellow in Undergraduate Education in 2008.

Kennedy, who has been deeply involved with students through advising and committee service, says she looks forward

PHOTO: L.A. CICERO

"My hope would be to think more about bringing service learning more deeply into the academic mission, integrating it into [students'] studies and into their intellectual lives."

to "taking Haas to a new level." She said that the center's new strategic initiatives, which focus on education, health and the environment, "speak to the academic experience here" but also to the "profound challenges" students will face in the future.

"My hope would be to think more about bringing service learning more deeply into the academic mission, integrating it into their studies and into their intellectual lives." She also hopes that through the Haas Center's work, more faculty members will integrate service learning into their research and teaching interests.

Dean's Message

I'm pleased to introduce another issue of our newsletter, highlighting some of our activities at the School of Earth Sciences. Our focus last year was on the fundamentals—recovering our financial equilibrium after a time of budget reduction, and re-establishing a strong foundation from which we can take the next steps in the school's evolution.

As always, your comments and suggestions are welcome and appreciated. My thanks for your continuing interest in our programs and our students.

With best wishes,

Pamela Matson

Pamela A. Matson

Chester Naramore Dean, School of Earth Sciences

Richard and Rhoda Goldman Professor of Environmental Studies

Left: Jessica Warren, Assistant Professor, Geological and Environmental Sciences; Right: Karen Casciotti, Assistant Professor, Environmental Earth System Science

Stanford Earth Sciences welcomes two new faculty members

Jessica Warren

Assistant Professor, Geological and Environmental Sciences

Jessica joined the Stanford Earth Sciences faculty this summer. She earned three degrees from the University of Cambridge, then completed her PhD in geochemistry and geophysics in a joint program of MIT and the Woods Hole Oceanographic Institution in 2007. Before coming to Stanford, Jessica was a postdoctoral fellow at the Carnegie Institution of Washington. Her research uses rocks collected at sea and on land to study processes within the Earth. She has a particular interest in the ridges and subduction zones that divide the planet into tectonic plates, the outward expression of convection within the Earth's mantle. Peridotites—direct samples of the mantle—collected from these areas allow exploration of processes such as ductile deformation, mantle flow, melting and magma transport, and mantle geochemical evolution. Jessica works on samples from a variety of field localities, including the Southwest Indian, Mid-Atlantic and Gakkel Ridges, the Tonga Trench, the Josephine Peridotite, and the Oman Ophiolite.

Karen Casciotti

Assistant Professor, Environmental Earth System Science

Karen will join the Stanford Earth Sciences faculty this winter. After earning a bachelor's degree from the California Institute for Technology and a master's degree from the Scripps Institute of Oceanography, she went to Princeton, where she earned an additional master's degree and her PhD in Geosciences in 2002. Before coming to Stanford, Karen was an NRC postdoctoral research associate at the U.S. Geological Survey, then an assistant scientist in the Department of Marine Chemistry and Geochemistry at the Woods Hole Oceanographic Institution. Her research focuses on nitrogen cycle biogeochemistry, including studies of how nitrate, nitrite, and nitrous oxide are produced and consumed in ocean waters. She uses a combination of stable isotope measurements and microbial community analysis to determine the sources and cycling of nitrogen in the coastal ocean.

New Office of Multicultural Affairs

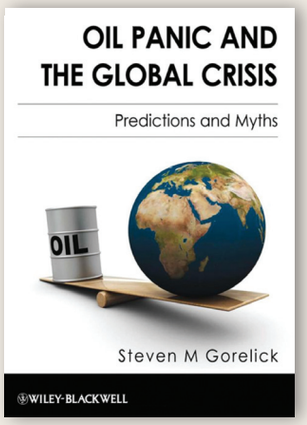
The School of Earth Sciences has established the Office of Multicultural Affairs (OMA), led by Professor and Associate Dean for Multicultural Affairs Jerry Harris. The mission of OMA is to promote an environment of inclusion, equity, and respect through the recruitment and retention of multicultural faculty, students, post-doctoral scholars, and staff, representative of our national communities. Our goals are to open new pathways for scholars from under-represented U.S. populations to study in the School of Earth Sciences, and to build collaborative, international partnerships that are aimed at assisting partners to build capacity for education and research in the geosciences and energy resources geo-engineering. One program will focus on recruiting excellence through increasing the pipeline to SES graduate programs; a new summer program beginning in 2011 will bring promising students to campus for an intensive eight-week research experience.

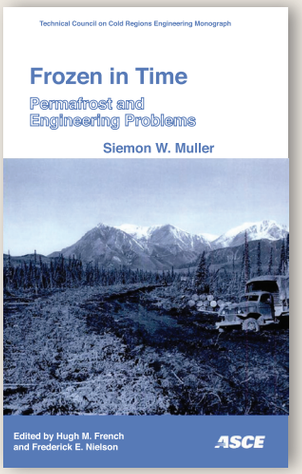
Support from the Chevron Corporation and the James Croswell Perkins Memorial Fund is helping to fund these efforts, as well as incentive programs for graduate students and postdoctoral scholars in under-represented groups. Dr. Priscilla Grew, a member of the School of Earth Sciences Advisory Board, established the James Croswell Perkins Fund in memory of her father, a Congregational minister who from 1957 to 1970 was professor and head of the Department of Philosophy and Religion at Huston-Tillotson College in Austin, Texas, an historically black institution celebrating its 135th anniversary this year as Huston-Tillotson University.

New books

Steven M. Gorelick, Cyrus Fisher Tolman Professor, Stanford University School of Earth Sciences, spoke to the PREA Quarterly earlier this year about his book, *Oil Panic and the Global Crisis: Predictions and Myths:* "Over the last 30 years, I have used geology and engineering to focus on environmental problems related to the protection and sustainable use of water resources. There is a technical overlap between my specialty in hydrogeology, which is the study of subsurface water, and petroleum engineering. The liquids are different but many of the principles are the same, so my work on oil resources is not a big stretch. Beyond that technical connection, I have maintained a long-standing interest in the potential depletion of natural resources. In the early 1980s, I initiated a Stanford course on Earth resources in which we exposed students to the interplay between physical depletion and the economics of essential mineral and energy commodities. During the past five years, with the support of the Guggenheim Foundation, I have dedicated significant effort to the study of global oil resources and making sense of the oil depletion debate."

Frozen in Time: Permafrost and Engineering Problems, is a previously unpublished work by Siemon W. Muller, author of the first English-language book about perennially frozen ground. Professor Muller remained at Stanford to join the faculty after earning master's (1929) and doctoral (1930) degrees from the School of Earth Sciences. He stopped working on the nearly completed manuscript in the early 1960s, and for reasons unknown set it aside about the time of the First International Conference on Permafrost in 1963. It remained "frozen" for several decades until it was eventually discovered in his files. Upon careful reading, the manuscript was found to offer an advanced and unusually comprehensive treatment of permafrost science and associated engineering problems. Editors Hugh M. French and Frederick E. Nelson guided this landmark manuscript through the last phase of revision, provided context through an interpretive introduction, and finally brought it to the publication stage. The book's dedication was written by Professor Muller's son, Eric Muller, who, along with his wife, Sherry, have endowed the Professor "Si" Muller Memorial Fellowship Fund at the School of Earth Sciences at Stanford.





Early Earth stayed warm because its ocean absorbed more sunlight; greenhouse gases were not involved, Stanford researchers say

PHOTO: L.A. CICERO

Minik Rosing, a geology professor at the Natural History Museum of Denmark, University of Copenhagen, and Dennis K. Bird, professor of geological and environmental sciences at Stanford.

"It's the same phenomenon you will experience if you drive to Wal-Mart on a hot day and step out of your car onto the asphalt," Bird said. "It's really hot walking across the blacktop until you get onto the white concrete sidewalk."

by Louis Bergeron, *Stanford Report*

Researchers have long wondered why water on Earth was not frozen during the early days of the planet, when the sun emanated only 70 to 75 percent as much energy as it does today. Some theorize that high levels of greenhouse gases in the atmosphere, the same mechanism cited in global warming today, were key. But new research involving Stanford scientists has a different explanation: The oceans, much larger than today, absorbed enough heat from the sun to avoid turning into ice.

Four billion years ago, our then stripling sun radiated only 70 to 75 percent as much energy as it does today. Other things on Earth being equal, with so little energy reaching the planet's surface, all water on the planet should have been frozen. But ancient rocks hold ample evidence that the early Earth was awash in liquid water – a planetary ocean of it. So something must have compensated for the reduced solar output and kept Earth's water wet.

To explain this apparent paradox, a popular theory holds there must have been higher concentrations of greenhouse gases in the atmosphere, most likely carbon dioxide, which would have helped retain a greater proportion of the solar energy that arrived.

But a team of earth scientists including researchers from Stanford have analyzed the mineral content of 3.8-billion-year-old marine rocks from Greenland and concluded otherwise.

"There is no geologic evidence in these rocks for really high concentrations of a greenhouse gas like carbon dioxide," said Dennis Bird, professor of geological and environmental sciences.

Instead, the team proposes that the vast global ocean of early Earth absorbed a greater percentage of the incoming solar energy than today's oceans, enough to ward off a frozen planet. Because the first landmasses that formed on Earth were small – mere islands in the planetary sea – a far greater proportion of the surface of was covered with water than today.

The study is detailed in a paper published in the April 1 issue of *Nature*. Bird and Norman Sleep, professor of geophysics, are among the four authors. The lead author is Minik Rosing, a geology professor at the Natural History Museum of Denmark, University of Copenhagen, and a former Allan Cox Visiting Professor at the School of Earth Sciences.

The crux of the theory is that because oceans are darker than continents, particularly before plants and soils covered landmasses, seas absorb more sunlight.

"It's the same phenomenon you will experience if you drive to Wal-Mart on a hot day and step out of your car onto the asphalt," Bird said. "It's really hot walking across the blacktop until you get onto the white concrete sidewalk."

Another key component of the theory is in the clouds. "Not all clouds are the same," Bird said.

Clouds reflect sunlight back into space to a degree, cooling Earth, but how effective they are depends on the number of tiny particles available to serve as nuclei around which the water droplets can condense. An abundance of nuclei means more droplets of a smaller size, which makes for a denser cloud and a greater reflectivity, or albedo, on the part of the cloud.

Most nuclei today are generated by plants or algae and promote the formation of numerous small droplets. But plants and algae didn't flourish until much later in Earth's history, so their contribution of potential nuclei to the early atmosphere circa 4 billion years ago would have been minimal. The few nuclei that might have been available would likely have come from erosion of rock on the small, rare landmasses of the day and would have caused larger droplets that were essentially transparent to the solar energy that came in to Earth, according to Bird.

"We put together some models that demonstrate, with the slow continental growth and with a limited amount of clouds, you could keep water above freezing throughout geologic history," Bird said.

(continued on page 11)

E-IPER joint MS graduates take the plunge

The Emmett Interdisciplinary Program in Environment and Resources (E-IPER) graduated its third cohort of joint master of science students, sending three joint MS-JD and six joint MS-MBA students on to a number of influential positions in non-profit organizations, law and investing firms, and clean energy businesses. A few of these students discuss their E-IPER experiences and career choices.

For Michael Dawson, who will be the director of business development for the energy efficiency company OPOWER, having the E-IPER joint MS was key to receiving the job offer, as E-IPER allowed him to show "the cleantech start-up community his seriousness about being a leader in that industry." Michael noted that "for a student interested in cleantech, E-IPER's joint MS is the only program covering solar technology, carbon sequestration, and smart grid, courses which are offered in several different departments on campus."

Tom Mercer, currently a research project manager with Stanford's Program on Water in the West, jointly led by the Bill Lane Center for the American West and the Woods Institute for the Environment, agreed with Michael about the professional value of the joint MS degree. Tom particularly appreciated the opportunity to explore a number of different interests in the environmental realm: from an initial interest in corporate sustainability strategy, to a collaboration with E-IPER PhD student Marilyn Cornelius on behavior change and residential energy efficiency, to his current work on water resources in the western United States.

Jared Thompson will begin his legal career with Hogan Lovells, a Washington DC-based law firm, but first he will spend a year working for the Natural Resources Defense Council on a fellowship focused on climate change and water resources that Jared credits, in part, to his E-IPER joint MS coursework. He also appreciated E-IPER's "wonderfully enriching intellectual experience" and the opportunity to build a professional network wider than the law school through his participation in the E-IPER community.

Greg Wannier, who will be a fellow at Columbia University's Center for Climate Change Law next year, echoed that the joint MS sends an important message to potential employers, "It shows that I have gone out of my way to understand the complex systems the law intends to regulate." Through his E-IPER coursework Greg gained an overview of the science underlying energy systems and climate change, noting several classes that should be required for anyone interested in practicing energy law.

Adelie Penguin (Pygoscelis adeliae), Vega Island, Weddell Sea, Antarctica, Robert B. Dunbar.

Anne Bernhardt and Lisa Stright receive fellowship funding from Schlumberger

Anne Bernhardt and Lisa Stright are the recipients of fellowship support from Schlumberger Limited. Both plan to complete their PhDs this academic year, and are working on companion dissertations.

Anne is originally from Berlin, Germany, and works in the sedimentary research group in the Department of Geological and Environmental Sciences with adviser Professor Don Lowe. Her project involves fieldwork in Patagonia, Chile, and Northern Austria, looking at deep-water sedimentary rocks.

Lisa grew up in Calgary, Canada, and is finishing her PhD in the Graduate Program for Earth, Energy, and Environmental Science, after earning a master's degree in petroleum engineering at Stanford. Her interest is in numerical modeling of deep-water deposits in Austria and Chile; she was the recipient of a Centennial Teaching Assistant Award in 2008, and received a Top 10 Oral Presentation of AAPG award in 2007.

Left: Anne Bernhardt; Right: Lisa Stright

"The idea of 'clean coal' is not realistic. Coal will never be clean," Wilcox says. "But as long as we're using it, we need to learn how to minimize its environmental impact."

Using the Ranger supercomputer, researchers simulated the behavior of trace metals in the flue of a power plant to learn how these metals interact and how they can be removed from the air.

Using supercomputers to clean up coal

Reprinted from futurity.org, a Web site that aggregates news from leading research universities in the United States, Canada, and the United Kingdom.

STANFORD/U. TEXAS-AUSTIN (US)—Pollution control devices known as scrubbers, installed to restrict the amount of nitrogen oxide and sulfur dioxide release from coal-fired power plants, may have helped to reduce acid rain, but they haven't made those plants safe.

Not even close, says Jennifer Wilcox, assistant professor of energy resources engineering at the Stanford School of Earth Sciences. She specifically cites the high levels of mercury, arsenic, and selenium that are still being discharged from power plants as public dangers.

"During combustion, coal is not burned all the way, and metals are released into the atmosphere," explains Wilcox.

About 5,000 tons of mercury are released worldwide from coal-fired power plants each year, according to the Environmental Protection Agency (EPA). Recently, scientists have determined that this mercury travels long distances and ends up in remote regions, like the Arctic, where it enters the food chain and accumulates within organisms.

Fish and polar bears have been found with dangerous amounts of mercury in their systems, and the people of the Arctic, who eat these animals, display elevated levels of toxic metals, which are correlated to birth defects and other ailments.

It's not possible to see inside the flue of the power plant where the gases interact, so Wilcox simulates the interactions of these particles using the Ranger supercomputer at the University of Texas at Austin's Texas Advanced Computing Center.

Her studies are helping to improve on current technologies and design new ones that can remove heavy metals from the coal combustion process.

Specifically, Wilcox's simulations show how the size, pore structure, and composition of a material affects its success as an oxidizer of heavy metals. According to Wilcox, the goal is to create a structure that will bind trace metal molecules and convert them into a water-soluble form that can be easily removed.

"The strategy of a company that makes scrubbers is to find something that mostly works and to go with it, but they have no interest in finding out why something works and even less interest in optimizing for enhancement," Wilcox says.

That's where Wilcox and her colleagues come in. Their simulations map the electronic structure and electron placement in the trace metals as they react with the *(continued on page 8)*

Stanford land-use expert brings satellite data down to Earth

by Daniel Strain, *Stanford Report*

To better understand what leads to environmental changes on Earth, Stanford's Eric Lambin combines remote satellite data with on-the-ground conversations with local residents. This in-depth knowledge may lead, for example, to less deforestation.

By integrating remote satellite imagery with revelations from door-to-door interviews, Stanford Earth Sciences geographer Eric Lambin and his colleagues are exploring the complex conditions that give rise to a broad range of land-use challenges – from the reforestation of Vietnam to the spread of Lyme disease in Belgium.

For decades, orbiting satellites have peered downward to gather information about the surface of the Earth, giving scientists an unprecedented view of the planet. Using this data, researchers have created maps of deforestation and other land-use changes over time.

Satellites are precise tools, able to measure the rate of photosynthesis in a tiny clump of trees in the heart of the Amazon Basin. But satellite technology reveals little about the people living beneath the canopy who decide the fate of the trees around them. For a deeper understanding of how and why humans alter their environment, researchers need to talk face-to-face with the people who live there.

"We really need a meeting between land-use studies and these new sources of information, like digital satellites," said Lambin, a professor of environmental Earth system science and a senior fellow at Stanford's Woods Institute for the Environment.

Through surveys and interviews, Lambin has uncovered the political, economic and social forces that contribute to the protection or destruction of forests and deserts across the globe.

"I develop integrated approaches to study land-use change by linking remote sensing and socioeconomic data," said Lambin, who divides his time between Stanford and the University of Louvain in Belgium, where he is a professor of geography. "To what extent do people have the technology or the knowledge to make the right land-use decisions? You can only answer that sort of question by interviewing people on the ground. You can't see that by satellite."

Eric Lambin in Tanzania, on the slopes of the Ngorongoro.

Reforestation and the secret furniture trade

Lambin has recently focused on land-use success stories – countries that have fostered the growth of forests or other wild spaces within their borders. "As you focus on the good news, you can find some political lessons that can be really useful for other countries," he said.

He first cast his magnifying glass on Vietnam. In the early 1990s, after an intense period of deforestation, a net reforestation occurred in the mountains that cover two-thirds of the country.

At the local level, the return of woodlands often stems from environmental awareness, Lambin said. "Farmers clear a watershed, then their fields get flooded, so they quickly understand the need to maintain forest cover," he explained. "Interviews with farmers in several Vietnamese villages revealed that land scarcity provided a strong incentive for the sound management of forests on hillsides."

On a larger scale, a suite of economic and social variables – not conservation ethics – gives rise to reforestation, he said. For example, when a country undergoes industrialization, farmers leave their paddies to find work in city factories. Soon, trees return to the abandoned farms.

While studying reforestation trends in Vietnam, Lambin read in a newspaper article that the country's furniture exports had quintupled *(continued on page 10)*

"We really need a meeting between land-use studies and these new sources of information, like digital satellites... To what extent do people have the technology or the knowledge to make the right land-use decisions? You can only answer that sort of question by interviewing people on the ground. You can't see that by satellite."

Chasing Giants, *a documentary by Earth Systems students Christopher Hanson and Chris Fedor, can be viewed at http://vimeo.com/10964829.*

Chasing Giants

Earth Systems students Christopher Hanson and Chris Fedor spent eight weeks in the far north of Norway shooting *Chasing Giants*, a documentary about the country's whaling culture. The film recently won in the student films category of the international 2010 BLUE Ocean Film Festival in Monterey, CA. Here's what they had to say about making the documentary:

"Norway is one of only three countries (Japan and Iceland are the other two) that have defied the International Whaling Commission by endorsing whaling. The Norwegians claim their fishery is sustainable, and unlike Japan, their fleet is small, private, and localized. Norwegian whalers only hunt in Norwegian waters, and they only kill minke whales, which are estimated to number in the hundreds of thousands. However, many scientists believe that these population estimates may be skewed, and whale numbers today are assuredly much less than they were before the rise of commercial whaling 200 years ago. Regardless of the science, whaling is a contentious issue that tugs at the heartstrings of society—the "save the whales" campaign is charged with overwhelming emotion (not just science). With the majority of the global community vehemently opposed to whaling, why does Norway, often regarded as an extremely environmentally progressive nation, continue to hunt whales?

Chasing Giants explores this contentious issue through the eyes of Norwegians themselves. Our aim was to investigate what the people of Norway have to say about the issue. The purpose of the film is not to be pro-whaling propaganda or anti-whaling public awareness, but rather to give a voice to people who are so often vilified in the media. As Americans, we really only hear the Greenpeace side of the whaling debate. As Earth Systems majors, we personally take a more objective, scientific approach. However, the Norwegians themselves are rarely (if ever) approached about the issue and asked to justify what they do. We are interested in constructing a more complete dialogue on whaling. Whatever one's leanings may be on the whaling debate, all parties can benefit by a clearer understanding of all perspectives and stakeholders."

Supercomputers

(continued from page 6)

materials in scrubbers. This helps develop a clear idea of why certain materials react better than others.

"Once we understand what the pathway is, then we can tune the catalyst or sorbent," she says.

Such simulations help scientists better understand the combustion process.

"Experimental results can be difficult to explain," says Nick Hutson, senior research engineer at the EPA. "Understanding the materials at a fundamental level allows you to progress to the point where you can start looking for real engineering solutions."

These engineering solutions can mean changes in the spacing of pores in a charcoal filter, or the creation of a never-before-seen alloy of palladium and gold that, Wilcox predicts, will better oxidize heavy metals in gasification.

In 2011, the EPA is expected to release regulations limiting the release of mercury and other heavy metals into the atmosphere. Power companies will be forced to adopt more efficient and effective technologies to protect the environment and avoid fines. Wilcox will be leading the way, having developed the theory and methods needed to produce optimal capture devices.

"The idea of 'clean coal' is not realistic. Coal will never be clean," Wilcox says. "But as long as we're using it, we need to learn how to minimize its environmental impact."

This work is supported by the National Science Foundation.

Top left: Aerial view of Mt. St. Helen's; Death Valley field trip. Left: Panorama north out of crater from September Lobe site on the old lava dome. Rainier and Spirit Lake in the distance, glacier to the left in the crater. Top: PhD student Kyle Anderson. Above: Approaching Mt. St. Helen's by helicopter.

Studying an active volcano in the Northwest

Geophysics Professor Paul Segall and PhD student Kyle Anderson are using one of eight American Recovery and Reinvestment Act awards received by the School of Earth Sciences to model the eruptive behavior of Mount St. Helens, the active volcano in southwest Washington.

Segall and his team are modeling how magma ascended from a magma chamber deep inside the mountain through a conduit to the surface during the 2004-08 eruption of the volcano. Changes in the forces exerted by the magma on the surrounding rock were measured at the surface using Global Positioning System (GPS) measurements. Also observed was the growth of a huge lava dome inside the volcano's crater by the slow accumulation of lava erupted at the surface.

By the end of the eruption, the dome had a volume of about 100 million cubic meters, which is about the size of 40,000 Olympic-sized swimming pools.

By comparing these observations with predictions from the model, Segall and his team are able to place constrains on the volume of the magma chamber, its pressure, the amount of gasses dissolved in the magma, and other important properties of the volcanic system.

By better understanding the volcano's internal activities, the team hopes to improve forecasts of eruptions around the world.

Interns measured approximately 36,000 species, contained in a total of 130 volumes. The primary objective of the project is to identify the environmental and ecological factors controlling evolution of size over the past 500 million years.

High School Internship Program

Twelve high school interns from all over the Bay Area spent eight weeks in Jonathan Payne's laboratory this summer assisting with one of his research projects. Payne, assistant professor of geological and environmental sciences, is interested in the relationship between environmental change and organism size, and is looking at foraminifera—single-celled, aquatic organisms—because foraminifera have an extensive fossil record. The descriptions of most species have been compiled in a single catalog, available at the Branner Earth Sciences Library. The interns measured the size of each species and compiled the geological age for the reference material of each species so that size trends could be compared to environmental changes over the past 500 million years. The interns were able to collect valuable data for the project and participate in data analysis during their time in the lab.

The Stanford School of Earth Sciences High School Internship Program hosted 31 high school students this summer, each volunteering about 15-20 hours per week. Interns participate in weekly sessions of lectures, lab tours, and field trips to broaden their understanding of the breadth of study of Earth sciences and to get to know other high school students. The program provides mentoring for young developing scientists, as well as mentorship training for graduate students.

Satellite Data

(continued from page 7)

from 1987 to 2006. He was mystified how a country with so little logging could produce so many couches and chairs.

He soon discovered that Vietnam wasn't using less wood overall, just less native wood. It turned out that most Vietnamese timber was coming from neighboring countries, such as Laos or Cambodia, where environmental laws are more lax. And nearly half of Vietnam's lumber imports were illegal, making them difficult to track and regulate, he said.

Global warming tools

The results of the Vietnam forestry study could have a significant impact on international efforts to combat global warming, Lambin said. The United Nations has proposed using "forest credits" as a tool to curb greenhouse gas emissions. The program would allow industries to emit carbon dioxide if they agree to fund the protection of woodlands in the developing world.

The ability to understand subtle land-use complexities, such as Vietnam's illegal lumber trade, may determine whether such programs succeed, Lambin said. "Land- use change is increasingly controlled by global forces, which are not completely controlled by individual countries," he added.

Even if two countries adopt the same environmental policies, they don't necessarily get the same results, he said. Differences in ecology, economic trends or even the motivation of individual farmers can mean that one country's forests flourish while the other's dwindle.

"Policymakers like simple, neat solutions," he said. "They tend to assume that one issue is caused by one set of factors, and, therefore, you need to apply the same remedies in all situations."

(continued on page 11)

Early Earth

(continued from page 4)

"What this shows is that there is no faint early sun paradox," said Sleep.

The modeling work was done with climate modeler Christian Bjerrum, a professor in the Department of Geography and Geology, University of Copenhagen, also a co-author of the *Nature* paper.

The rocks that the team analyzed are a type of marine sedimentary rock called a banded iron formation.

"Any rock carries a memory of the environment in which it formed," Rosing said. "These ancient rocks that are about 3.8 billion years old, they actually carry a memory of the composition of the ocean and atmosphere at the time when they were deposited."

Another constraint on early carbon dioxide levels came from life itself.

In the days before photosynthetic organisms spread across the globe, most life forms were methanogens, single-celled organisms that consumed hydrogen and carbon dioxide and produced methane as a digestive byproduct.

But to thrive, methanogens need a balanced diet. If the concentration of either of their foodstuffs veers too far below their preferred proportions, methanogens won't survive. Their dietary restrictions, specifically the minimum concentration of hydrogen, provided another constraint on the concentration of carbon dioxide in the atmosphere, and it falls well below the level needed for a greenhouse effect sufficient to compensate for a weak early sun.

"The conclusion from all this is that we can't solve a faint sun paradox and also satisfy the geologic and metabolic constraints by having high carbon dioxide values," Bird said.

But the theory of a lower Earthly albedo meets those constraints.

"The lower albedo counterbalanced the fainter sun and provided Earth with clement conditions without the need for dramatically higher concentrations of greenhouse gasses in the atmosphere," Rosing said.

Satellite Data

(continued from page 10)

Disease in a changing world

Lambin has taken his research a step further by exploring the relationship among land, humans and disease-carrying parasites, such as ticks and mosquitoes.

In Belgium, Lyme disease is common among the urban middle class but rare among the rural poor, Lambin said. The ticks that carry Lyme disease run free in parks and forests where people jog or bike but not in farmlands. However, Belgian farmers are more likely to contract a type of Hantavirus that lies in wait in soil dust, he added.

In northern Thailand, when loggers chop down trees, the forest opens and the puddles that breed malaria-causing mosquitoes evaporate, he said. When the deforested areas are converted into fruit orchards, the malarial mosquitoes are replaced by a different species that carries dengue fever – the leading cause of hospitalization and death among Thai children.

Using satellite land-cover maps, epidemiological data and surveys of farming households, Lambin and his colleagues concluded that the shift from malaria to dengue fever was in large part caused by the presence of fruit workers in what had been a remote forest. "As you change land use, you're changing the habitat of the mosquito," he explained. "But most importantly, you're changing where people go and at what time of the day."

For Lambin, diseases are one more example of the complexities hidden within the static pixels of satellite images. "When you have so many variables interacting, the outcome is always contextual," he said. "The time is ripe for an overarching theory of land change that explains the behavior of people as well as land use."

Daniel Strain is a science-writing intern at the Woods Institute for the Environment at Stanford University.

Class Notes

(Alumni with multiple degrees are listed under their first degree year.)

1948

George MS '48 and **Greta** BS '49 **MacLeod** write, "We have very exciting news to share. The MacLeod Family Vineyard was featured in the July 2010 issue of Travel + Leisure magazine. Apparently, they found our small, family-run operation, and our quest for true Sonoma Valley terroir, to be an interesting topic. And we're not going to argue with them."

1949

Selma Moses Bonham MS '49 writes, "In my city of Mill Creek, Washington at the annual 5K "Run of the Mill" on July 10, another blue ribbon (my 10th) for women age 80+. I'm 85. I also have three previous red ribbons for this event. Entry fees go to assist cancer patients. There was no competition in the 80+ age group among the almost 2,000 participants. There were not any women in the 70+ category either, but some men in their 70s beat me. My son (but no grandkids) was with me this time. Yes, I ran without walking, but don't ask my time."

1950

Edward Mayer, BS '50, born on January 30, 1928 in Los Angeles, CA, died on January 19, 2010. He is the father of David (Billie) and Thomas Mayer and was the proud grandfather of Paul Mayer. He was predeceased by wife, Ann S. Mayer, and is survived by friend, Elizabeth Maine, as well as numerous other adoring friends. After graduating from Los Angeles High School, he received a BS degree in Petroleum Engineering from Stanford University and an MS degree in Petroleum Engineering from USC. He was the recipient of a Stanford Associates Award of Merit. He was a licensed engineer in California, and during a career that spanned 50 years, worked as a petroleum engineer for Chevron, Monterey Oil, Exxon and Occidental. He served as chief staff engineer and senior engineering advisor for THUMS Long Beach Company during nearly 30 years at that company. He was recognized as an innovator in technology application and leader in professional activities by the Society of Petroleum Engineers, which bestowed Honorary Membership on him in 2006, its highest honor. His involvement in and dedication to the SPE led him to serve on the local, regional and national level. He is recognized for formulating the Standard Symbols for Reservoir Engineering used in his industry. In addition to his career, he enjoyed travel, photography and riding steam trains. These pursuits led him to travel around the world.

Bert Murphy BS '50 writes in with an update on his life since Stanford. Bert attended Stanford on the GI Bill after service as a WWII U.S. Army non-commissioned officer from 1944 to 1946 (ages 17 to 19). He later received a direct commission to the U.S. Naval Reserve from 1951 to 1961. He retired in 1992 at the age of 65 as Major General and an Assistant Adjutant General of New Mexico as well as a military advisor to the Governor of New Mexico. He is a Registered Professional Engineer in Texas and New Mexico. He is also an independent oil producer and has been the owner of Murphy Minerals Corporation since 1957.

He married Martha Redding AB '49 in 1949. Martha worked as a librarian in the Los Angeles library system, at The Huntington library and art museum and at Stanford's Hoover Library. She taught for seven years and was a recipient of the Governor's Award for Outstanding New Mexico Women. Martha served on several boards and was nominated by Senator H. Schmitt to the U.S. Federal Reserve Board and by President George H. W. Bush for a Thousand Points of Light Award. Bert and Martha have now been married 60 happy years. Martha is active in children's charities and with Bert continues in the oil business in addition to traveling and writing.

Together with SES Dean Allan Cox, Bert and others reactivated the School of Earth Sciences Petroleum Investments Fund (PIF) that provides funds under the discretionary control of the dean. He was chairman of the reactivated Petroleum Investments Committee (PIC) for its first five years from 1980 to 1984. His daughter Ann served as chair from 1999 to 2000. Both are active emeritus members. In 1982 Bert recruited his long time friend **W. Frank West** (deceased) AB '47, MS '48 to the PIC. West did outstanding work raising funds to build the principal of PIF II. The two investments funds now have a total value of $39 million and provide more than $1 million each year to the school. Since semi-retiring in 1992, Martha and Bert have written and published five books including a novel, a children's book, and three books about historical travel.

Of the Murphy's four children, three are in the oil business and one is a teacher. Their youngest daughter, **Ann Murphy Daily** BS '79, UCLA DJP '82, was the first teaching assistant for Professor Al Horn. She is president of the Board of Regents at New Mexico Tech and is active in petroleum law and, with her husband, in the petroleum business. The Murphy's oldest daughter, Laura, is a special education teacher and does charity work. Their oldest son is an independent oil producer and is active in politics. He is also the director of the Smithsonian Air and Space Museum and a past chairman of the Research Partnership to Secure Energy for America (RPSEA). RPSEA has approximately 140 members from large and small research facilities and universities. The Murphy's

youngest son is an independent oil and gas producer and one of the world's experts in coal bed methane (CBM) development and production. He is currently in China consulting on CBM.

The Murphys consider Stanford and New Mexico Tech like Fountainheads "where the rolling foothills rise up toward mountains higher."

1953

Congratulations to **Thomas Davies Barrow** PhD '53 on receiving the Stanford Associates Governors' Award recognizing exemplary volunteer service to the University over an extended period and to Janice Barrow AB '50 for her membership to Stanford Associates.

1956

William (Bill) Travers BS '56, MS '59 reports that he turned over the job of managing Anacapa Oil to his son, Bill. Bill Sr. lives in Hailey, Idaho (near Sun Valley) and visits Carpinteria in November, April and May. He offers, "Call if you are near!"

1957

William Carls BS '57, MS '58 is studying climate change in the Mediterranean. He writes, "My wife, Clarice, and I are in the Naples area to concentrate on the Italian islands, many of which we visited by sailing with Italian friends we've known from years ago. My study will gather data on past and current rain fall patterns, what the islands are doing to address climate change, and energy and environmental projects that might be funded by the government to mitigate potential future water short falls."

1963

Steve Rose BS '63, MS '70 is living on Vashon Island, Washington in the summer and in Taos, New Mexico in the winter. He's been happily married to Nancy (Weidemann) Rose AB '63 for 43 years. Their daughter, Kathleen, and two grandchildren live in Houston, Texas. Although available for consulting, Steve is more of a full-time orchardist on their three acre farm on Vashon Island. Steve was with ARCO for almost 30 years before taking early retirement. Altogether he has worked in 15 countries in five continents as a petroleum engineer and manager. He has been a member and is the past chairman of the Petroleum Investment Committee.

1964

Judy Terry Smith MS '64, PhD '68 is a former director of the Earth Sciences Fund at Stanford. She is delighted to be back as a volunteer for the 25th anniversary of the Stanford-USGS Fellowship Fund. She and her husband of over 40 years, **Jim Smith** MS '63, PhD '67 have relocated to the Washington, DC area. Jim is a USGS Emeritus Scientist, and Judy is a research associate in the Department of Paleobiology at the Smithsonian National Museum of Natural History.

1968

John Randolph Sumner MS '68, PhD '71 was named Fellow, Geological Society of America, 2001, and Life Member, the Society of Exploration Geophysicists.

1970

Hugh Davies PhD '70 completed a two and a half year secondment to the Papua New Guinea (PNG) Mineral Resources Authority in December 2009. While with the Authority his task was to rebuild the PNG Geological Survey by selective recruitment and establish best practice protocols and procedures so that the Survey would be an effective scientific arm of government. His models were the U.S. Geological Survey and Stanford Earth Sciences, as he came to know them in the 1960s, and Geoscience Australia where he worked for 33 years. He says "The experience made me more aware of the truism that change has many enemies and few supporters. This is perhaps especially so in the case where a scientific body is part of an essentially administrative and bureaucratic organization." Hugh also became aware of some of the negative effects of foreign aid. On the plus side, he organized and led an excellent team of young people and was able to positively impact many young scientists and other professionals. In 2010 he resumed teaching and research at the University of Papua New Guinea where he lives on campus with his wife Connie and daughter Joc. The university graduates 20-25 geologists each year, he reports, most of whom are snapped up by exploration and mining companies. More than 50 PNG geologists currently are working overseas in Africa, Asia, Indonesia and Australia.

Ahmed El-Hawat MS '70 reports on his time after Stanford, writing, "Since I was interested in working on shallow water deposits that the European schools were actively perusing at the time, I decided to go to the Imperial College London to do my PhD research. The school was pioneering research on the modern siliciclastic sediments of the Wash tidal flats and the Persian Gulf carbonates. The rest is history. Although everyone thought I was totally mad to leave Stanford, I decided to go. I have the fondest memories of my days at Stanford in the late 60's. Also, I met and fell in love with a young British woman who was working as an assistant librarian in the old Branner Library. She became my wife!"

1971

Larry Beyer PhD '71 reports that he retired from the U.S. Geological Survey (USGS) in 2005 but maintains emeritus status. His latest effort is USGS Professional Paper 1759. He continues annual backpacking trips in the High Sierra, California.

1974

Randall White BS '74, MS '74 writes, "I have been serving as chief geophysicist for the Volcano Disaster Assistance Program, a joint program with the Office of Foreign Disaster Assistance (U.S. State Department) and the U.S. Geological Survey (U.S. Department of Interior) for the last 15 years. As such I am the primary eruption forecaster for our six person team. We have provided well over 50 successful eruption forecasts (with no significant errors) for more than

35 volcanoes to the governments of 17 countries. Our forecasts, based primarily on seismicity patterns, specify eruption type and explosivity for the following two week window, sometimes for longer windows. In addition to forecasting, we have also provided major upgrades to 22 volcano observatories worldwide and trained their personnel in volcano monitoring and forecasting techniques."

1976

Richard Sears BS '76, MS '76 retired from Shell in 2009 after 33 years with the company. He is still a visiting scientist at MIT and recently was appointed a senior science and engineering advisor to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling.

Karen Walz BS '76 (Environmental Earth Sciences) continues to live in Dallas and remains the principal in the planning consulting firm of Strategic Community Solutions. She provides strategic planning, visioning, long-range planning, and public engagement services to public and non-profit clients. She is the project manager for Vision North Texas, a private-public-academic partnership that released 'North Texas 2050' in March of this year. This document establishes a vision and action package to address the growth of the fourth largest metropolitan region in the nation, Dallas-Fort Worth, which is expected to nearly double its population to almost 12 million by 2050. Karen is a member of the College of Fellows of the American Institute of Certified Planners, the highest level of professional recognition for this field. In August, Karen was married to her 'significant other', Terry Morgan. Their wedding at the Stanford Memorial Church was a wonderful celebration of their relationship (over the past 22 years and into the future) as well as an opportunity to reconnect with friends and family from many places. Guests included Karen's friends, classmates, and roommates from Stanford, some of whom she hadn't seen in many years. She says it was really wonderful to have this special event as a new connection to Stanford.

1977

Stewart Levin MS '77, PhD '87 reports that both he and Landmark colleague **Cynthia Chen** BS '02, MS '02 volunteered at the Aurora, Colorado Prairie Middle School "College Day" in June. He says, "I represented Princeton, but the kids made a bee line for her Stanford table."

1979

Pamela Corrie BS '79 writes, "After working as a geologist in Texas, I went back to school and got a law degree. I'm living in Connecticut after spending a decade in Manhattan. I am married with a teenage son and daughter."

After 30 years as a faculty member and administrator at Arizona State University, **Jonathan Fink** PhD '79 is moving to Portland State University to serve as vice president for research and strategic partnerships. While at ASU, Jon was chair of the Department of Geology, vice provost and vice president for research, and director of the Global Institute of Sustainability. In Portland he will pursue his research and policy interests in volcanology and in urban sustainability.

1983

Sandy MacFarlane MS '83 writes, "At the moment my work with RLG is taking me to the oil fields in Alaska. Last year I worked on a rig in Trinidad. I am working two weeks on/two weeks off and living in the Sierra foothills about three and a half hours drive from Stanford."

1984

Mehmet Akalin MS '84 works for Petronas Carigali in Kuala Lumpur, Malaysia as the principal of seismic imaging and processing. Of special interest is imaging below gas-clouds, fractured basements, and fluid saturation estimation from seismic using primarily streamer hydrophone data and secondary the use of P-to-SV converted wave and PP data acquired with 4-Component OBC-Ocean Bottom Cable data.

Hormoz Ameri MS '84 is the co-founder and CEO of Naftex Operating Company, a California based oil and gas production company. Hormoz is also the chairman of the California Independent Petroleum Association and the chairman of Stanford's Petroleum Investments Committee.

1985

Jean Bahr MS '85, PhD '87 writes, "I have been a faculty member at the University of Wisconsin since 1987. During my sabbatical in 2009-10, I served as president of the Geological Society of America."

1986

Sally Newton-Buynoski BS '86 reports that she is a master gardener and a white water raft guide. She comments that her time is "spread thin between duties as domestic diva, gardening, quilting and (still) working on that novel. And yes, I still look at the occasional rock."

Carol Mann MS '86 writes, "I've been working for Dynamic Graphics for 22 years now working on geospatial software programs. The last seven years, I've been a project manager, developing new state-of-the-art directional drilling software (in conjunction with Baker Hughes) that incorporates asset team data into the planning and drilling stages – our attempt to break down the communication and visualization barriers between the G&G and Drilling communities. It's a lot of fun, and I've been learning so much. I get to see some alums at various shows: AAPG, SEG, and SPE, which is fun too. Hope all is well."

1988

Richard Herrmann MS '88 is the VP of global information access with IHS in Denver, Colorado. His product management team is responsible for all of the critical information access and delivery products and technologies for their global energy business. He reports that he is still deeply involved in the oil and gas industry and geotechnical and

GIS application space. He and his wife, Lynelle Bautista, BS '87, MS '89, are enjoying raising their twins: daughter, Dylan, and son, Ryan, in Colorado with the wonderful quality of life that comes along with living in the Rocky Mountains.

Kate Miller MS '88, PhD '91 writes, "After 18 years at the University of Texas at El Paso, I have recently moved to Texas A&M to be dean of the College of Geosciences."

1990

Naomi Oreskes PhD '90 co-authored a book titled Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming which was released in May.

1991

Rob Gailey MS '91 is an independent consulting hydrogeologist working on water supply and groundwater contamination cases in the western U.S. He reports that work is still plentiful and includes both technical and expert witness engagements. "Through a combination of focused marketing and luck," he writes, "my projects are quite interesting and often publishable (if only I had adequate time for that!). I live in the San Francisco Bay Area with my wife and two children (ages 8 and 11). I am also serving my second term as president of the Board of Directors at my kids' school."

1995

Bill Faries BS '95, MS '97 was named the Argentina Bureau Chief for Bloomberg News in May. Bill has been a reporter and editor in Argentina, Bolivia and Indonesia since leaving Stanford. He and his wife, Dana Peterson BS '94 have lived in Buenos Aires since 2006 and are the parents of 9 month old Dylan. He writes, "Some people might ask what earth systems has to do with a finance-based news agency like Bloomberg, but the same cross-discipline understanding required to get a grip on complex issues like climate change applies to the relationship between governments, financial markets and social/cultural movements. We'll be at the Stanford reunion in October and can't wait to catch up with old friends and check out all the developments on campus."

1997

Alice Marie Cathcart BS '97, MS '00 just joined the solar power systems group at SunPower Corporation in April 2010. She is looking for large rooftops on commercial buildings!

1999

Kris Ludwig BS '99 writes that she completed her PhD in oceanography at the University of Washington in 2008. After a year of working at a museum managing an ocean science education program, she moved to Washington DC last fall to take a position in science communications for scientific ocean drilling programs at the Consortium for Ocean Leadership. She reports that she's enjoyed the diversity of her responsibilities, which range from science writing and congressional outreach to media relations and teaching marine geology at sea in their annual "School of Rock" program. She's also had the chance to reconnect with Stanford SES faculty and students through her position and looks forward to seeing colleagues at AGU this fall.

2003

Twila Moon BS '03 is with the Big Sky Institute (associated with Montana State University), which focuses on the science of the Greater Yellowstone Ecosystem. She writes, "If any fellow alums are working on science in this region, please get in touch! Otherwise, I'm enjoying skiing in my own backyard; a nice change from UW Seattle, where I finished off a MS degree."

2009

Mindi Summers BS '09 is in a graduate program at the Scripps Institution of Oceanography. She is participating in the CalEchoes cruise "Exploring California's Ecological Changes and Historical Origins." She invites you to check out the research experience, curriculum and learning plans for teachers at http://calechoes.ucsd.edu.

Congratulations

Our congratulations also go to the parents of Stanford's class of 2010:
Lawrence R. Bernstein PhD '85
Cheryl Cape BS '79, MS '81
Mohammad Reza Fassihi MS '77, PhD '81
Mary Rose Fitch BS '82
Matthew W. Grode BS '85
Nicholas Josten BS '80
Daniel May BS '78
Carl Michelsen BS '82
Daniel John Ponti BS '77, MS '81
Syed Mohammad Tariq MS '75, PhD '78
Sarah Dabney Wright BS '80

Farewell

Edward Mayer, Born on January 30, 1928 in Los Angeles, CA and died on January 19, 2010. He is the father of David (Billie) and Thomas Mayer and was proud grandfather of Paul Mayer. He was predeceased by wife, Ann S. Mayer and is survived by friend, Elizabeth Maine, as well as numerous other adoring friends. After graduating from Los Angeles High School, he received a BS degree in Petroleum Engineering from Stanford University and an MS degree in Petroleum Engineering from USC. He was a licensed engineer in California, and during his career that spanned 50 years, worked as a petroleum engineer for Chevron, Monterey Oil, Exxon and Occidental. He served as chief staff engineer and senior engineering advisor for THUMS Long Beach Company during nearly 30 years at that company. He was recognized as an innovator in technology application and leader in professional activities s by the Society of Petroleum Engineers, which bestowed Honorary Membership on him in 2006, its highest honor. His involvement in and dedication to the SPE led him to serve on the local, regional and national level. He is recognized for formulating the Standard Symbols for Reservoir Engineering used in his industry. In addition to his career, he enjoyed travel, photography and riding steam trains. These pursuits led him to travel around the world.

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STAY IN TOUCH!

Let us know what you're doing now! Send updates and news items, and any questions you have about upcoming events, to Mona Tekchandani ('96), director of alumni relations and the Earth Sciences Fund: monalisa@stanford.edu or 650.723.2101.

A new Stanford Earth Sciences Web site coming soon at earthsci.stanford.edu.