Feature
Earth: Inside-Out. We can't see it, can't touch it. How can we know what's inside? EAPS geoscientists have the tools and tenacity to tease apart just how the interior of the earth works.

News
Introducing new Assistant Professor Greg Fournier • Three faculty earn tenure appointments • Faculty Awards and Honors • Research Highlights • 2013/2014 Degrees Awarded

Friends
Read about past and future EAPS lectures and events • Meet our new student fellows • Find out how you can help us to continue to attract the best and the brightest to EAPS
Dear Alumni and Friends,

The new academic year is well underway and the Department of Earth, Atmospheric and Planetary Sciences is again abuzz with activity—with a fresh intake of students, research and course offerings of an extraordinary variety, and lively seminars and special lectures almost daily.

Our students are truly the engines of EAPS research. This fall we welcomed 21 new graduate students from seven countries, and we are delighted to report that two EAPS Visiting Committee members have committed to support our graduate students again this year: George J. Elbaum ’59, SM ’63, PhD ’67 continues his support of two Whiteman Fellowships, and Neil Rasmussen ’76, SM ’80 has established the endowed Norman C. Rasmussen Fellowship Fund, annually supporting two graduate fellows in climate science, in perpetuity. And, earlier this year, Arthur C. H. Cheng ScD ’78 launched the Sven Treitel ’53 Graduate Student Support Fund and is rallying support from his peers to honor the renowned geophysics alumnus. Other exciting news about fellowships will be announced soon.

To acknowledge all of our leading fellowship donors, in the spring we will launch the EAPS Patrons’ Circle, honoring their contributions and providing a celebratory opportunity for them to meet “their” students. With help from our friends, my goal is to continue to build fellowship resources until we can support all EAPS graduate students throughout the two years before their qualifying exam. Having assured “no-strings-attached” funding, regardless of the restrictions of grant funding, enables EAPS to continue to attract the best and brightest students, and allows them the freedom to explore their strengths.

I thank you all for supporting the Department of Earth, Atmospheric and Planetary Sciences, and hope that our paths cross during the coming year!

Sincerely yours,

Rob van der Hilst
EAPS Department Head and Schlumberger Professor of Earth Sciences
FEATURE STORY — EARTH: INSIDE-OUT

Can’t see it. Can’t touch it. How can we know what’s going on inside? EAPS geoscientists have the tools and tenacity to tease apart just how the interior of Earth works.

EAPS FACULTY NEWS

2014 was another year of notable faculty achievements. We greeted a new member while three of our current faculty were awarded tenure, and numerous prestigious distinctions were earned.

RESEARCH HIGHLIGHT:
BUILDING AFRICA’S FIRST CLIMATE OBSERVATORY

No long-term greenhouse gas observing station exists on the entire African continent—covering a fifth of the world’s land area, this is no small piece of lost data. EAPS grad student, Jimmy Gasore, is working to change that.

RESEARCH HIGHLIGHT:
MEASURING THE MIGRATION OF A RIVER

Taylor Perron’s group reveals how river networks transform the landscape on a geologic time-scale, sometimes in unexpected ways.

RESEARCH HIGHLIGHT:
WEIGHT OF THE WORLD

Until now, determining the masses of smaller, potentially life-supporting exoplanets has been a challenge—EAPS graduate student Julien de Wit and supervisor Sara Seager propose a promising new technique to overcome this.

DEGREES AWARDED

In the 2013-14 academic year EAPS awarded 43 degrees—from PhD to Master’s and Bachelor’s—showcasing an impressive range of thesis topics.

EVENTS, ALUMNI & FRIENDS

Read more about EAPS’ year full of riveting feature lecture events, exciting new fellowship opportunities, and good news from friends.
EARTH: INSIDE-OUT

How do you look inside a rock the size of a planet?

By Helen Hill, EAPS Science Writer
LOOKING INSIDE THE earth using seismic or other forms of geophysical imaging has important applications in the search for and responsible extraction of natural resources like oil, gas, mineral deposits and water. It has a role too in improving scientists’ understanding of geologic hazards, such as enabling them to predict the ground motion in an earthquake. It also provides data leading to a deeper understanding of the fundamental processes at work in the heart of our planet with implications for planetary science in general.

MIT has long boasted world-class expertise in geophysics, and geophysical imaging. Sven Trietel ’53, SM ’55, PhD ’58 (this issue), and contemporaries in the MIT Geophysical Analysis Group (GAG), can be credited with establishing digital subsurface mapping as a central technique underpinning much of modern oil and gas exploration.

Today, members of what ultimately has become EAPS, many of them affiliated with the Earth Resources Laboratory (ERL), carry that torch forward. As MIT’s primary home for research and education focused on subsurface energy resources, researchers in ERL combine contemporary advances in geophysical imaging with rock physics and chemistry, multiphase flow, geomechanics, microseisms, and remote sensing to obtain
a holistic understanding of sub-surface reservoirs—their structure, the geological materials of which they are made, the fluids that flow through them, and changes that occur in response to production.

For example, Cecil and Ida Green Professor of Earth Sciences and Director of the ERL Brad Hager uses seismic data in conjunction with other geophysical measurements like GPS to understand surface deformation, earthquakes, and dynamical processes in Earth’s interior. Senior Research Scientist Mike Fehler (ERL’s Deputy Director) develops and tests novel methods for seismic imaging that can be applied to a number of problems in reservoir characterization including identification of changes in reservoirs, identification of fractures, and the relationship of induced seismicity and reservoir structure. Associate Director and Chair of EAPS Program in Geophysics Dale Morgan’s research interests, which run the gamut from geo-electromagnetics to rock physics, applied seismology to environmental and engineering geophysics, also often rely heavily on seismic imaging. Schlumberger Professor of Geosciences and Head of EAPS Rob van der Hilst, in addition to an interest in subsurface reservoir science, images Earth’s deep interior to understand more about the thermal and chemical state of our planet and its links to surface processes. Finally, Assistant Professor Germán Prieto (more below) seeks an improved understanding of the diversity of earthquakes and the associated ground motions expected on the surface.

Here we focus on the work of three particular EAPS geophysicists developing and applying the tools and techniques of geophysics to turn the Earth: Inside-Out.

**LISTENING TO SEE**

Along with destruction, earthquakes provide scientists with important information about the structure of Earth’s crust and upper mantle.

EAPS Assistant Professor of Geophysics Germán Prieto grew up in the seismic hot zone of Colombia, an experience which developed in him an early interest in seismology. Among Prieto’s interests are ambient seismic fields. Once regarded as nothing more than noise, these signals have recently been shown to provide important information about Earth’s structure. Surface wave tomography, body wave tomography both for crustal and deep interfaces, crustal anisotropy, attenuation tomography, and basin amplification have all been studied using these signals.

By looking at the spatially coherent signals between seismic stations, under certain conditions, researchers are able to extract

**USING MATH TO SEE**

Graduate student Lucas “Bram” Willemsen (EAPS’ first Toksöz fellow) is exploring new techniques for estimating elements in the approximate Hessian, a matrix operator fundamental in numerical techniques used to construct velocity models of the subsurface from seismic measurements. The more accurate a velocity model is, the more focused the seismic images will be.

Exactly calculating and storing all the terms in this matrix is often too computationally demanding. Willemsen is seeking to develop a more tractable reduced form, extracting the essence of the full expression while minimizing the computational overhead. Willemsen benefits from ERL’s interdisciplinary focus, often turning to mathematicians affiliated with the lab, such as Laurent Demanet, Assistant Professor of Mathematics.
an impulse response record similar to the Green’s function of the medium; as if one station behaved like a source and the others were recording the response of Earth’s crust and upper mantle. In current work, Prieto is exploring what additional information can be gleaned from the amplitudes of these empirical Green’s functions, both in time and frequency domains, to see structural variations within the ground even more clearly.

DEEPPENING OUR UNDERSTANDING OF THE DEEP EARTH

There remain deep unanswered questions about the large-scale processes that occur inside our planet, even fundamental processes that are important to the evolution of life are not necessarily well understood.

Postdoctoral Associate Elizabeth Day, working with Rob van der Hilst and graduate student Chunquan Yu, uses seismic imaging to seek a deeper understanding of mantle dynamics and Earth’s evolution over geologic time.

Focusing specifically on the seismic structure of the mantle beneath Hawaii, Day, Yu and van der Hilst are trying to understand its source within the deep Earth. What path do the hot plumes that form Hawaii take through the mantle? What is the composition of the mantle in this region? Answers to these and questions like them will hopefully lead to a better overall understanding of how the mantle convects.

Since without mantle convection it is unlikely that there would be plate tectonics, and without plate tectonics it is unlikely that life as we know it would have developed on Earth, this work could have profound implications for our deeper understanding of the early Earth and its subsequent evolution, as well as our understanding for other rocky planets.

Read the full story:

IS YOUR NAME ON THE GEOPHYSICS CAN?

FOR CLOSE TO THIRTY YEARS, EAPS geophysics graduate students, on passing their General Exams, have traditionally added their names to a ceremonial soup can. Diligently passed down from generation to generation, the can currently resides on a shelf in an undisclosed student office in the ERL. Is your name among this auspicious roll call of former EAPSters?

You can check out all the faces of the can at:

Where are you now? Get in touch to let us know where your post-EAPS life has taken you by sending an e-mail to:
eapsnewsletter@mit.edu

LEFT
Graduate student Lucas “Bram” Willemsen benefits from ERL’s interdisciplinary focus, collaborating with both his EAPS advisor, Assistant Professor Allison Malcolm, and mathematicians from MIT’s Math Department.

CENTER
In the field checking a GPS antenna, postdoc D. Sarah Stamps works with EAPS Professor Brad Hager, and is also a National Geographic Explorer.

RIGHT
Graduate student Alan Richardson proudly points to his entry on the EAPS Geophysics Can, a longstanding tradition.
THREE FROM EAPS AWARDED TENURE

Congratulations to Tanja Bosak, Paul O’Gorman, and Taylor Perron for their recent tenured appointments in recognition of their achievements, and their contributions to the School of Science.

Tanja Bosak

Associate Professor Bosak’s research in experimental geobiology is widely recognized for its singular creativity, breadth, and rigor, placing her among the leading geobiologists of her generation. Her work addresses the role of microbes in the profound environmental changes, such as the rise of atmospheric oxygen, that were integral to the co-evolution of life and the surface environment throughout the first 80% of Earth’s history (when microbes were the only form of life).

Paul O’Gorman

A world-expert in “moist dynamics” (the fluid- and thermodynamics of moist atmospheres), Associate Professor Paul O’Gorman studies the influence of water vapor on how the atmospheric general circulation and the hydrological cycle respond to climate change. With a unique ability to link theory, idealized modeling, the behavior of complex models, and observations, O’Gorman fills a gap between global modeling and fundamental understanding. He has now emerged as one of the leaders in atmospheric dynamics and modern climate theory.

Taylor Perron

Associate Professor Perron’s overall scientific goal is to discover and quantify the processes that shape landscapes on Earth and other planets. His work combines theory, observations, and laboratory experiments to reveal how a planet’s geologic and climatic histories are recorded in its topography. He is a world expert in crafting elegant models of landscape evolution and comparing their predictions with field and remote sensing observations to discover new ways of “reading” a landscape’s history.
CONGRATULATIONS TO TIMOTHY GROVE, EAPS Associate Department Head and Cecil and Ida Green Professor of Geology, who was elected to the American National Academy of Sciences in April.

Grove’s research focus is on the processes that have led to the chemical differentiation of the crust and mantle of Earth and on the processes of formation and evolution of the interiors of other planets, the moon, and meteorite parent bodies. Combining geology, geophysics, and geochemistry to interpret the thermal histories of geologic materials, his group studies magma generation processes, crystal growth and nucleation, phase transitions in minerals, diffusion in crystalline solids and silicate melts, and the time dependence of diffusion-controlled processes.

Grove holds a PhD from Harvard (1976) and has been a professor at MIT since 1979. He is a member of the American Academy of Arts and Sciences, Fellow of the Minerological Society of America, the American Geophysical Union, and the Geochemical Society, and he is the recipient of the 2014 Goldschmidt Award of the Geochemical Society. He was President of the American Geophysical Union from 2008-2010. He is the executive editor for Contributions to Mineralogy and Petrology.

EAPS WELCOMES A NEW FACULTY MEMBER

INTRODUCING GREG FOURNIER who joins EAPS as an Assistant Professor of Geobiology.

Fournier’s research links early Earth geochemistry with life history using DNA sequences from extant genomes. Specifically, he is an expert in the use of fossil/biochemical age calibrations of horizontal gene-transfer (HGT) events to time-calibrate the “Tree of Life.” His work has identified the HGT origin of acetoclastic methanogenesis, demonstrating its consistency with the Permian-Triassic extinction. Fournier also revealed the impact of partial gene transfer on the eukaryote “Eocyte” hypothesis, establishing the evolution of Eukarya involved two histories and not a single evolution from Archaea.

Fournier received an A.B. in Genetics from Dartmouth (2001) and a PhD in Genetics and Genomics from the University of Connecticut (2009). Since then he has worked as a Postdoctoral Associate at the University of Connecticut and, in the past four years, as a Postdoc in MIT’s Department of Biological Engineering.

GREG FOURNIER
EAPS newest Assistant Professor
CONGRATULATIONS TO ROB VAN DER HILST, Schlumberger Professor of Earth Sciences and EAPS Department Head, for his election to the American Academy of Arts and Sciences, one of the nation’s most prestigious honorary societies. Its current membership includes more than 250 Nobel laureates and more than 60 Pulitzer Prize winners.

Rob’s research focuses on the understanding of Earth’s deep interior structure and its evolution over long periods of geological time. Using seismic methods he explores Earth’s interior, all the way down from the crust we live on to the core-mantle boundary which lies some 2,800 km beneath us.

Rob holds a PhD from Utrecht University and has been a member of the EAPS faculty since 1996. His other honors include a Packard Fellowship and the James B. Macelwane Medal from the American Geophysical Union, in addition to an AGU Fellowship.

OTHER RECENT FACULTY AWARDS AND HONORS

Ed Boyle Awarded the 2014 Urey Medal of the European Association of Geochemistry

Clark Burchfiel Received the Geological Society of America International Section’s Distinguished Career Award for 2013

Glenn Flierl 2015 American Meteorological Society Henry Stommel Research Award; American Geophysical Union Fellow

Fred Frey Geological Society of America’s Mineralogy, Geochemistry, Petrology, and Volcanology Division 2014 Distinguished Geologic Career Award

Tom Herring Was elected as a Fellow of the American Academy of Arts and Sciences

Taylor Perron Is the 2014 recipient of the American Geophysical Union Macelwane Award

Dan Rothman Was elected as a Fellow of the American Geophysical Union

Noelle Selin 2014 Appointee to the Global Young Academy, an international group of two hundred young scientists selected based on research excellence and commitment to impact.
PROFESSORS Tanja Bosak, Mick Follows, and Roger Summons are all recent awardees of the Simons Foundation, a private foundation established in 1994 by James H. Simons ’58 and Marilyn Simons to advance the frontiers of research in mathematics and the basic sciences through sponsorship of a range of programs that aim to promote a deeper understanding of our world.

Beginning in 2013, the Simons Foundation launched a program of new funding opportunities for collaborative research on the origins of life, and on ocean processes. As a result, three EAPS investigators have so far benefited from the generous grants made available through this new interdisciplinary initiative.

Hayes Career Development Associate Professor of Geobiology Tanja Bosak and Professor of Geobiology Roger Summons received funding as part of the Simons Collaboration on the Origins of Life. Bosak’s project explores signatures of biological and environmental co-evolution on the early Earth. Summons’ project, entitled, “Seeking Evidence of Earth’s Earliest Biogeochemical Cycles,” is trying to answer the questions: What is the earliest record of microbial life? and How can geochemistry constrain the timing and environments of the origin and early evolution of life?

Associate Professor Mick Follows received funding as part of the Simons Collaboration on Ocean Processes and Ecology (SCOPE) for work interpreting the organization of microbial communities—like plankton—in the North Pacific using theory and numerical simulations.

EAPS is honored to participate in these important collaborative projects, thanks to the Simons Foundation.
GETTING AFRICA ON THE CLIMATE CHANGE GRID

Graduate student and Rwandan native Jimmy Gasore is helping to build Africa’s first climate observatory.

Story by Jimmy Gasore

The exponential increase of greenhouse gases since the industrial revolution has and continues to shift the global climate. Strategies for emissions reduction are usually implemented at the national and regional level, requiring those emissions and the geographical distribution of their sources to be known on corresponding length scales.

Greenhouse gas emissions and source distribution information is, in general, readily available across the developed world. A different picture, however, emerges from developing countries; for example there exists no long-term high frequency greenhouse gas observing station on the entire African continent. Covering a fifth of the world’s land area, this is no small piece of lost data. Thus, the ultimate goal of my research project: Getting Africa on the climate change grid.

As part of my doctoral work in EAPS, I am helping Professor Ron Prinn, and Research Scientist Kat Potter, build the first high frequency climate observatory station in Africa. Located in the Republic of Rwanda, the station will be part of the Advanced Global Atmospheric Gases Experiment (AGAGE), joining a worldwide network of stations that have been measuring global atmospheric composition continuously since 1978.
Choosing the right place to host the climate observatory was a challenge by itself. First logistical considerations like power, accessibility and laboratory space were considered. Second and most important were technical considerations: the station had to be away from cities and towns and high enough to avoid contamination by local sources. The station “footprint”, which can be thought of as a map of all possible origins of air masses arriving at the station within a year, was also key in determining the scientific usefulness of the station.

The criteria were met by Mount Karisimbi, a 4500m extinct volcano located in the northwest of the Republic of Rwanda. Computer simulations indicate that an observatory at this location would be able to sample air masses from Egypt and Saudi Arabia to the North, India and the Indian Ocean to the east and Madagascar to the south, together with African countries to the west.

As well as setting up the station, I will use inverse methods to estimate surface sources and sinks of carbon dioxide and methane. The process of estimating these quantities is like putting a gas molecule in a time machine and tracking it back to where it was originally emitted. When a gas is released by human activities, like cars and power plants, or natural processes like wetland respiration, it undergoes physical processes including mixing and transport by winds, chemical transformation fueled by solar radiation, as well as chemical reactions with other atmospheric constituents. In combination, these physical and chemical processes determine the concentration of a given gas measured at a particular time and place.

Inverse emissions estimation starts by measuring atmospheric concentrations of greenhouse gases and meteorological information, and then, thanks to an elaborate chemical and physical computer model (that time machine I mentioned), estimating what was emitted at the surface and where, by carefully taking the molecule back through all the chemical transformations and physical mixing it has undergone.

At the end of this project, my goal is to be able to provide the first comprehensive regional high-frequency observation-based emissions estimate for Central and Eastern Africa. This information will then form the basis for regional carbon policies as well as improving our current understanding of the global carbon budget. Furthermore, the estimated sources and sinks of carbon dioxide and methane will provide additional data for comparison with global inversion studies and ecosystem model calibration, as well as regional emissions verification.

MEASURING THE MIGRATION OF A RIVER

Taylor Perron’s group has developed a mapping technique to measure how river networks change, and in which direction they may be moving.

By Jennifer Chu, MIT News
ARGE RIVER NETWORKS — such as those that funnel into the Colorado and Mississippi rivers — may seem to be permanent features of a landscape. In fact, many rivers define political boundaries that have been in place for centuries.

But scientists have long suspected that river networks are not as static as they may appear, and have gathered geologic and biological evidence that suggest many rivers have been “rewired,” shifting and moving across a landscape over millions of years.

Now EAPS professor Taylor Perron, together with former postdoc Scott McCoy and others, have developed a mapping technique that measures how much a river network is changing, and in what direction it may be moving.

The technique focuses on a river network’s drainage divides—ridgelines, such as along mountain ranges, that act as boundaries between two river basins. As rainwater flows down either side of a drainage divide and into opposing rivers, it erodes the underlying rock. The river on one side of a divide may erode faster than the other, creating an imbalance in the river network. To reach a balance, they reasoned that a drainage divide must shift to assume a more stable pattern.

The team came up with a measurement technique to determine the direction in which a divide would have to move to bring its river networks into balance, and then made these measurements in actual landscapes, including regions in China, Taiwan, and the southeastern United States. They found that while some river networks matched the stable pattern—suggesting they are relatively static—other networks, such as those in the southeastern United States, produced patterns implying that these regions are currently shifting and changing.

Read the full story:
New method examining dips in light during planetary transits may help scientists to determine the mass of individual exoplanets.

To date, scientists have confirmed the existence of more than 1,000 exoplanets circulating outside our solar system. To determine if any of these far-off worlds are habitable requires knowing an exoplanet’s mass—which can help tell scientists whether the planet is made of gas or rock and other life-supporting materials.

But current techniques for estimating exoplanetary mass are limited. Radial velocity is the main method scientists use: tiny wobbles in a star’s orbit as it is tugged around by the planet’s gravitational force, from which scientists can derive the planet-to-star mass ratio. For very large, Neptune-sized planets, or smaller Earth-sized planets orbiting very bright stars, radial velocity works relatively well. But the technique is less successful with smaller planets that orbit much farther from their stars, as Earth does.

Now graduate student Julien de Wit and advisor Professor Sara Seager have developed a new technique for determining the mass of exoplanets, using only their transmission spectra—dips in light as a planet passes in front of its star. This data has traditionally been used to determine a planet’s size and atmospheric properties, but the MIT team has found a way to interpret it such that it also reveals the planet’s mass.

Read the full story: http://bit.ly/eaps-exoweight
BRINGING GLOBAL WARMING SCIENCE FROM CLASSROOM TO THE WORLD

Kerry Emanuel is teaching a new massive open online course on MITx.

By Vicki Ekstrom, MIT Energy Initiative (MITEI)

NOT ONE TO shirk the spotlight in the cause of educating the public about climate change, Kerry Emanuel launched 12.340x Global Warming Science, a new massive open online course (MOOC) through MITx, which is part of the larger edX platform—a non-profit online collegiate-level learning initiative created by founding partners Harvard and MIT.

Climate change is widely recognized as one of the foremost challenges of this century—one with major repercussions for energy, health, agriculture, and more. Kerry Emanuel, MIT’s Cecil and Ida Green Professor of Atmospheric Science, therefore feels it is his duty as a citizen and scientist to educate a broad audience on the possible impacts of climate change.

Emanuel’s approach to teaching the class maintains a clear boundary between the science and the policy of climate change. “Part of the problem is all the publicity on global warming has sent out a message that global warming is highly politicized, and has nothing to do with science,” he said in a recent interview, “Nothing could be further from the truth.”

Emanuel is pleased with interest in the course; more than 10,000 people have registered. One of the benefits of the online class, he reflects, is that students can sign up and take the class wherever they live. This spring saw students from all over the world, including India, Bangladesh and several African countries signing up. “It allows me to reach people who might be very bright, very engaged, possibly future leaders in the field, who otherwise don’t have the opportunity to take a real college course at a real college because of financial, political, or other reasons,” Emanuel says. “This opens up a world to them. If they’re motivated, I think they can get just as much, if not more, out of the edX platform as someone taking it in the classroom.”


Check out all of the MITx and edX course offerings at: www.edx.org
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### MASTER'S DEGREES AWARDED 2013-2014

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MIT CORPORATION
MEMBER Neil Rasmussen ’76, SM ’80 and Anna Winter Rasmussen have supported two graduate fellows in climate science every year for the past three years. While attending the John Carlson lecture and dinner recently, Neil and Anna had an opportunity to meet the 2014-15 fellows, and announced they have decided to endow the fellowship fund in perpetuity.

Naming the new fund in honor of his late father, Norman C. Rasmussen—who was Professor of Nuclear Engineering at MIT from 1958-1994, and who served as the Department Head for Nuclear Engineering from 1975-1981—Neil spoke eloquently about what he and Anna hoped to achieve: “It is our hope that these fellowships will allow ‘out-of-the-box’ thinking and research in climate science. An improved understanding of how our climate works is urgently needed so mankind can better grasp the long term consequences of the decisions our societies are making every day.”

Professor Rasmussen was the first to apply probabilistic risk assessment techniques to nuclear power plant safety studies, and he debated the risks publicly in the ’60s and ’70s when nuclear power development was tremendously controversial. During many lively debates in crowded lecture halls, and even on TV with people like Henry Kendall and Ralph Nader, Norman Rasmussen always maintained that the unfettered burning of fossil fuels could pose a serious risk to society in the future, and that the continued development of safer nuclear power technology might provide a valuable option for us to meet the growing energy needs of mankind with lower risk to our planet.

“My father dedicated his career to trying to improve the understanding of societal risks. Advancing our understanding of climate science is a fitting way to honor his legacy.”

THE 2014-15 RASMUSSEN FELLOWS:

Tom Beucler

Tom graduated from the École Polytechnique in Paris where he studied math, physics, chemistry and fluid dynamics. Working with his advisor, Kerry Emanuel, Tom is now researching the formation of cyclones and seeking to understand the physics of convection.

Katie Castagno

Katie is an MIT-WHOI Joint Program student with a master’s degree in Marine Affairs from the University of Rhode Island. Katie is, “passionate about policy surrounding the ever-changing coastline.” Currently she is researching paleotempestology in the northeastern U.S., with her WHOI supervisor, Jeff Donnelly.
EAPS WELCOMES A NEW SENIOR DEVELOPMENT OFFICER

ANGELA ELLIS JOINED EAPS as Senior Development Officer in July, moving across from MIT Resource Development where she had been Associate Director of Foundation Relations since December 2011, supporting faculty in the life sciences. Before coming to MIT, Angela had worked for The Nature Conservancy for 9 years—raising funds for land and water conservation and other regional and global environmental programs. “It’s great to have “Earth” back in my job description”, said Angela, “I’m thrilled to be here and enjoying getting to know EAPS faculty members, alums and donors. It already feels like home.” Angela looks forward to meeting many more EAPS alums and friends at the upcoming AGU conference. If you’re going, please make sure you stop by the EAPS reception to meet Angela!

THE 2014 JOHN CARLSON LECTURE

PETER MOLNAR, RECIPIENT of the Royal Swedish Academy of Sciences’ 2014 Crafoord Prize for Geophysics, drew a crowd of 250 to the New England Aquarium IMAX Theater for the 4th Annual John Carlson Lecture, entitled “Big Cats, Panamá, And Armadillos: A Story of Climate and Life,” sponsored by the Lorenz Center, on October 16th.

Molnar, Professor of Geological Sciences and Fellow of the Cooperative Institute for Research in Environmental Sciences at the University of Colorado at Boulder, gave a fascinating talk that led the audience to ponder what really led to the Great American Biotic Interchange of species almost 3 million years ago.

After the lecture, and some probing questions from the audience, 75 guests joined lecture benefactor and host John Carlson, along with MIT School of Science Dean Mike Sipser, New England Aquarium President Nigella Hillgarth, and EAPS faculty and students for a dinner to continue lively discussions about climate and the Lorenz Center’s work.

The Lorenz Center is a climate think tank based in EAPS devoted to fundamental inquiry and cross-disciplinary, curiosity-driven research, drawing on the expertise of scientists and engineers from across the MIT campus.

The Annual John Carlson Lecture communicates exciting new results in climate science to a general audience. Free of charge and open to the general public, the lecture is made possible by a generous gift from John H. Carlson.

Kerry Emanuel, Cecil and Ida Green Professor of Meteorology, and Daniel H. Rothman, Professor of Geophysics, are co-directors of the Lorenz Center, which is named in honor of their late colleague Edward N. Lorenz, a pioneer of chaos theory and an early contributor to climate science.
THE SVEN TREITEL ’53 GRADUATE STUDENT SUPPORT FUND
Honoring a pioneer of modern oil and gas exploration

IN TODAY’S DIGITAL era, it is hard to imagine that the oil and gas industry once relied on labor-intensive interpretations of analog signals to determine where to drill. Nowadays, the industry is one of the most computer-intensive. Exploration would be unthinkable without the digital methods of subsurface mapping first conceived in a small lab in MIT’s legendary Building 20 back in the 1950s. This is where Sven Treitel, then a student working with the Geophysical Analysis Group (GAG), began to apply mathematician Norbert Weiner’s ideas to see if a computer could process seismograms more accurately than students poring over photographs with magnifying glasses. This research laid the groundwork for the “digital revolution” in exploration seismology.

Born in Germany and raised in Argentina, Sven Treitel ’53, SM ’55, PhD ’58 spent 9 years studying Geology and Geophysics at MIT. As a Course XII graduate student he supported his studies by working in the GAG, a research group sponsored by oil and geophysical service companies. Although by 1957, GAG’s industrial sponsors believed that the research had run its course, Sven Treitel trusted in its potential to change the landscape of geophysical exploration, and dedicated years of his career at Amoco to developing and refining digital signal processing.

In honor of Sven Treitel’s extraordinary contribution to geophysics, EAPS alum Arthur Cheng, Sc.D. ’78 (XII), Professor of Civil and Environmental Engineering at National University of Singapore, has launched a new Graduate Student Support fund in his name with a generous five-year pledge. “Sven Treitel was a visiting professor at MIT when I was a graduate student and he was a great role model for me”, says Dr. Cheng, who is now spearheading efforts to build the Sven Treitel ’53 Graduate Student Support Fund to $1M, adding: “Now is the perfect time to acknowledge Sven’s giant contribution to geophysics.”

THE NEED FOR SUPPORT

Graduate students play a vital role in EAPS by conducting advanced research, teaching and mentoring undergraduates, and helping to attract world-class faculty. Our goal is to build the Sven Treitel ’53 Graduate Student Support Fund so it will provide a full fellowship for an EAPS graduate student every year, in perpetuity. We invite you to join us in honoring the lifetime achievements of Dr. Sven Treitel by contributing to the Sven Treitel ’53 Graduate Student Support Fund. Your gift in any amount is greatly appreciated. For more information, please contact Angela Ellis, EAPS Senior Development Officer at 617-253-5796 or aellis@mit.edu

To make a gift online please visit:
http://bit.ly/eaps-giving and choose the Sven Treitel ’53 Graduate Student Support Fund (3312160)
We are delighted that the Theodore Madden Fellowship fund reached the $1M benchmark, enabling EAPS to award its first Madden Fellowship this academic year. Our inaugural Theodore Richard Madden ’49 Fellow is Haoyue Wang, a graduate student in the Earth Resources Laboratory currently studying the interaction between carbonate rock and acidic fluid, in search of a better injection strategy for CO₂ sequestration. Haoyue attended Peking University, receiving a BSc in geology in 2009 and a BA in economics in 2011.

We are grateful to all who helped us to launch the Madden Fellowship Fund. Leadership donors included John S. Reed ’61, Donald Paul ’67, Jie Zhang PhD ’97 and Crafoord Geosciences. If you missed the opportunity, and would like to make a contribution, donations can be made to the Theodore Richard Madden ’49 Fellowship Fund (#3305800) by mail or online: http://bit.ly/eaps-giving

Read more and watch video of the symposium: http://bit.ly/eaps-madden
FORMER EAPS PROFESSOR, now NASA Curiosity Rover chief scientist John Grotzinger, was the featured speaker at the First Annual Brace Lecture “Exploring Mars with the Curiosity Rover: The Search for Ancient Habitable Environments.”

On Friday May 9, over three hundred faculty and students, together with members of the public, packed the Stata Center Lecture Hall for a high tech trek from Earth to Mars and then on, following in the Curiosity Rover’s dusty tracks, from Gale Crater into an alluvial fan towards the foothills of Mount Sharp.

For a little over an hour, Grotzinger’s talk put the audience back in the NASA control room of “7 minutes of terror” fame, and then firmly on the surface of the Red Planet itself, “dust on feet,” boring into the ground, looking over the shoulder of NASA scientists seeking an answer to the question “Could life have flourished in this now arid and inhospitable place?”

Read more and even watch the full lecture: http://bit.ly/eaps-brace2014

EAPS traces its origins to the founding of MIT by the geologist William Barton Rogers in 1861. Today, members of the EAPS Department seek to understand the history of solar systems, the origin and evolution of Earth’s crust, atmosphere, hydrosphere and biosphere, as well as human impacts on the environment.

Intended as an annual vehicle for showcasing this huge interdisciplinary reach, the Brace Lecture is being established to honor the first Head of EAPS, William F. Brace, and share the physics, chemistry, biology, mathematics, and even engineering, which go on inside the Green Building.

The William F. Brace Annual Lecture Fund has been established to endow this lecture series in perpetuity. To make a gift in honor of William F. Brace, please visit our online page at: http://bit.ly/eaps-giving and select the William F. Brace Annual Lecture Fund (3839360); or use the enclosed envelope to send your gift by regular mail.
Chen Gu has been named as the second M. Nafi Toksöz Fellow in Geophysics, which is particularly fitting as her primary academic advisor is Professor Nafi Toksöz himself. Interested in the Earth and planets since she was a child, Gu, originally from Sezhou, China, came to the Earth Resources Lab in EAPS in 2010 as it offered, “one of the greatest geophysics programs in the world.”

“It’s a special honor to be named as the Toksöz fellow,” says Gu, “Professor Toksöz cares for his students as if they were his own kids and works very hard to support our ideas, help us solve problems and to prepare us professionally.”

Gu’s research involves studies of hydrofracturing-related acoustic events and induced seismicity in oil/gas fields. In her spare time, she is active in leading both Chinese and geophysics student activities and enjoys tennis and Chinese arts such as calligraphy and gu-qin music.

EAPS Visiting Committee member George J. Elbaum ’59, SM ’63, PhD ’67 and his wife Mimi Jensen have committed to funding the Whiteman fellowships again this academic year. This will not only help 2nd year EAPS graduate student Mingwei Li for the year, but also fellow students Sandra Shedd and Jared Atkinson for the Spring term.

Li’s research is about predicting future Chinese anthropogenic emissions of air pollutants and their impacts on the air quality over the U.S.

Shedd has two research projects which look at the response of precipitation to climate change from different angles; and Atkinson’s research has led him to explore the nascent science of space resource extraction—with a view to potential asteroid mining.

We look forward to introducing all of our graduate fellows to their generous sponsors at the EAPS Patrons’ Circle kick-off on April 9th!
FELLOWSHIP FUNDING ENSURES that EAPS can maintain its edge in attracting the very best graduate students. Department Head Rob van der Hilst is delighted, therefore, that EAPS is to add two new endowed fellowship funds to its previous roster of five: the Norman C. Rasmussen fund (see this issue) and the Callahan-Dee Fellowship Fund recently established by Patricia Callahan '75, SM '77 and David Dee. Rob’s ultimate vision is to be able to fund all of our graduate students during their first two years at MIT, to give our students maximum flexibility to unleash their natural curiosity and explore different research interests. With help from Eric Michelman '76, SM '78 we have also established the EAPS Graduate Student Support Fund where alums and friends can make annual gifts to support our students.

To honor all of our generous fellowship donors, EAPS is launching the Earth, Atmospheric and Planetary Sciences Patrons’ Circle – a new recognition group for our leadership donors who have made a gift or pledge of over $70,000 to endowed or expendable fellowship funds. This will include those who have provided for graduate fellowships in their estate plans. Patrons’ Circle members will be invited to a celebratory annual event every Spring, where donors, fellows and faculty can meet over dinner to share their research and to build friendships. The kick-off event will be held on Thursday April 9th at MIT.

If you would like to become a member of the EAPS Patrons’ Circle, consider making a gift or pledge of $70,000 or more to an EAPS fellowship or graduate student support fund, or establishing your own fund named in honor of a family member, faculty, student, or friend.

Contact Angela Ellis for more information at aellis@mit.edu or 617-253-5796.

We are grateful to our founding Patrons’ Circle members:

- Roger J. & Noreen A. Breeding
- Patricia Callahan & David Dee
- Arthur C.H. Cheng
- George J. Elbaum & Mimi Jensen
- Breene & Sheryl Kerr
- Eric Michelman
- Neil E. Rasmussen & Anna Winter Rasmussen
- John S. & Cynthia L. Reed
- Jie Zhang

UPCOMING EAPS EVENTS

Dec 15  EAPS Reception at the American Geophysical Union Conference
Jan 21  MIT Club of Northern California event with John Marshall
Feb 5  Author’s Night with Clark Burchfiel
Feb 19  School of Science Breakfast with Dan Cziczo
Apr 9  EAPS Patrons’ Circle Reception
May 8  Emma Rogers Society Spring Insider Series with Sara Seager, for widows and widowers of MIT faculty and alumni/ae
Jun 4  Doctoral Hooding and Luncheon
June 5  Commencement and Reception

Keep up with events at: eapsweb.mit.edu/events
The Department of Earth, Atmospheric and Planetary Sciences (EAPS) is the place at MIT where the turbulent oceans and atmospheres, the inaccessible depths of inner Earth, distant planets, and the origins of life all come together under one intellectual roof.

EAPS is about hard, quantitative science, known for its emphasis on academic rigor, hands-on training, collaboration, and the cross-fertilization of ideas—encompassing atmospheric science, climate, geobiology, geology, geochemistry, geophysics, oceans, and planetary sciences.

Above all EAPS is a vibrant learning community, preparing undergraduate and graduate students to be future leaders in academia, government, and industry. Through fieldwork, theory, experimentation, and modeling, we seek to advance understanding of the natural world. While our emphasis is on answering fundamental scientific questions, our work can also have important implications in addressing our current global challenges, such as climate change, air pollution, the sustainable use of the world’s resources, and natural hazards.

SUPPORT THE DEPARTMENT

Support the Department

Help EAPS maintain a competitive edge by making a contribution to one of our graduate student support or fellowship funds (list below). EAPS graduate students are the lifeblood of our department, teaching and mentoring undergraduates and forging new paths of research. Your gift could help provide students with the freedom and flexibility to complete their coursework and pursue research interests. With a gift or pledge of $70,000 or more, become a founding member of the new EAPS Patrons’ Circle!

- EAPS Graduate Student Support Fund (3857220)
- M. Nafi Toksöz Fellowship Fund (3311750)
- Sven Treitel ’53 Graduate Student Support Fund (3312160)
- Theodore Richard Madden ’49 Fellowship Fund (3305800)

To establish a new fund for EAPS graduate students, please contact Angela Ellis.

EAPS Discretionary Fund

Give EAPS the flexibility to address unforeseen challenges and take advantage of exciting opportunities by making an unrestricted gift to the EAPS Discretionary Fund (2734903). This fund allows faculty, researchers, and students to pursue ideas deemed too risky for federal funding, to undertake field research or travel to conferences, and it can also support much-needed upgrades of laboratory equipment.

To learn more about our funding priorities please visit us online:
http://eapsweb.mit.edu/alumni/giving

Or contact: Angela Ellis
EAPS Senior Development Officer
617.253.5796 | aellis@mit.edu

To give online visit: