

epicenters

The Newsletter of the Department of Earth and Planetary Sciences at Northwestern University | 2010

JUDD A. AND MARJORIE WEINBERG COLLEGE OF ARTS AND SCIENCES

Game Changer: Integrated Labs for Earth & Planetary Science

Over the last several months, movers have transported analytical instruments, glassware, drawers of carefully labeled rock samples, maps, and file cabinets from Locy Hall north to the first and third floors of the O.T. Hogan Building. Meanwhile, new supplies and instruments have streamed into the Hogan loading dock, the most exotic being the Pico-Trace Metal-Free Clean Laboratory for radiogenic isotope research. The angular 1960s Hogan building belies its newest high-tech tenant: the Integrated Labs for Earth and Planetary Science, or ILEPS. More than three years in the making, the department's new facility houses some of the most modern and advanced instrumentation for re-

search in biogeochemistry and high-pressure mineral physics.

At the time when the department was most recently recruiting junior faculty, Department Chair Brad Sageman articulated the need for a 21st century analytical facility to the administration. Winning the support of Provost Dan Linzer was instrumental - once that happened the wheels started turning. Sageman has overseen the lab's development, along with Andy Jacobson and Steve Jacobsen who were mem-

bers of a faculty "Space Committee" during the planning and
continued on page 12

Message From the Chair



Greetings to Alumni and Friends,

It's that time of year again, when the snow on the ground is still reasonably white, final grades for the Fall Quarter have been submitted, and a large contingent of the department has departed for San Francisco and AGU 2010.

It's quiet around Locy Hall and I am struck by a strong feeling of nostalgia for this plain old building. Locy certainly has its warts, but it also retains the character of an old fashioned geology department. Construction of the Tech infill is progressing and our move in a year or two is imminent. They call this progress, and for

many good reasons it is.

But we will sorely miss the tall ceilings, wood trim, and massive windows that give Locy its special charm.

Physical space does not define a department. The quality of space that the university *Continued on Page 2*

Message From the Chair

continued from page 1

provides may influence what we can do, but it is our people and their achievements that truly distinguish us. In the past year the faculty, students, and staff of the Department of Earth and Planetary Sciences have continued to excel and the university is nearing completion of our stunning new analytical facility in Hogan Hall. The Hogan labs have the potential to be a game changer for the department. Among its research group leaders we count two Packard Fellows and two NSF-CAREER awardees. Numerous other sponsored projects are also actively supporting research in the labs. But the activity in Hogan is only part of the story. Our geophysics faculty have several exciting new initiatives underway as well. The graduate student population is at a high point and continues to grow. Our undergraduate major is also maintaining the highest numbers we have seen in many decades. And in the past year, some of our faculty have been further recognized for the excellence and impact of their scientific contributions. I am very pleased to report that the department continues to be an wonderfully vibrant and highly productive community.

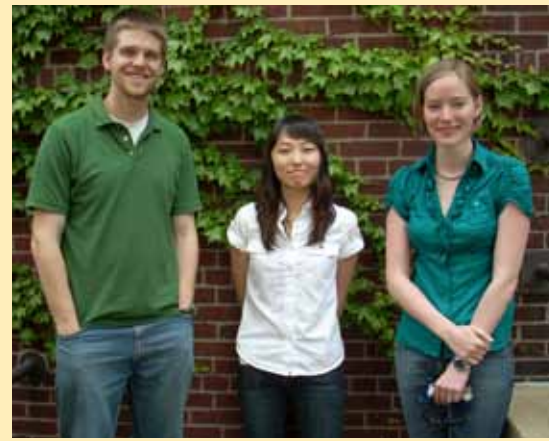


These successes and more are described in a series of articles in this year's newsletter. We also include a section with news from alumni – please continue to send us your news! As always, we extend our heartfelt gratitude for the contributions you have made this year – your gifts provide critical support for our teaching and research programs and everyone in the department recognizes how lucky we are to have such supportive alumni. Thanks again for your support, and have Happy Holidays and all the best in 2011

Cheers,

Graduate Fellowship Awards

The EPS graduate program has broken past records for success in prestigious external fellowship competitions. Quite a number of graduate students in EPS have recently been recognized with outside fellowships. Carl Ebeling last year was awarded a NSF Graduate Fellowship for his innovative work on identifying hurricanes in seismic noise. This year Emily Wolin received an honorable mention for her NSF Fellowship proposal. Both Rosemary Bush and Greg Lehn were recognized by EPA in being awarded STAR graduate fellowships, Rosemary for her work on molecular isotopic analysis of plants for climate reconstruction, and Greg for his work in tracking Arctic climate change through measuring Ca isotopes. Two faculty members, Francesca Smith McInerney and Andrew Jacobson were themselves EPA STAR Fellows as graduate students, so it seems fitting that their current advisees are being similarly honored. Maya Gomes currently has a NASA Graduate Fellowship for research on modern lakes and their sulfur isotopes. As a department, we take particular pride in Young Ji Joo, who was awarded a Schlanger Fellowship by ODP, a program in honor of Sy Schlanger (Department Chair, 80's). This award supports Young Ji's study of Cretaceous ocean anoxic



Fellowship awardees Greg Lehn, Young Ji Joo and Rosemary Bush

events, episodes that were first identified by Sy Schlanger and colleagues. Indeed, the number of fellowships—and their variety—greatly exceeds previous years. Also, we note that the recipients of the fellowships have five different advisors, so the awards are nicely distributed throughout the department. A number of graduate students have just applied for the latest round of NSF and EPA fellowships. Graduate students are encouraged to undertake proposals in support of their research, and many apply for the NSF, EPA, and NASA fellowship programs. In addition, the Graduate School hosts workshops on applying for these external fellowships, and our faculty advise on the proposals and regularly serve on the fellowship selection committees.



Department Chair, Brad Sageman, describes the accomplishments of EPS Minor, Teresa Wong, while her parents and peers look on.

EPS Graduation Reception

This June, we held a heartwarming reception for our eight graduating seniors in 2010 and their proud families. A faculty mentor stood by each student, sharing their adventures in learning together. We are proud of the close ties we build with our students and especially of the substantial research opportunities available to all of them. The fond farewell by the faculty advisor is sure to become a new EPS tradition. Congratulations graduates!

For undergraduate research titles, see page 10.

Hurtgen Wins NSF CAREER Award

Last May, Matt Hurtgen received the prestigious Faculty Early Career Development (CAREER) award from the National Science Foundation (NSF). The NSF CAREER program recognizes and supports early career development of those teacher-scholars who are most likely to become the academic leaders of the 21st century. CAREER awardees are selected on the basis of creative career-development plans that effectively integrate research and education. He received this award for his proposal “The Role of Sulfur in Regulating the Marine Carbon Cycle: Implications for Understanding Oceanic Anoxic Events.” Hurtgen’s research will be integrated with an education outreach effort developed through the Office of STEM Education Partnerships in the School of Education and Social Policy at Northwestern to develop laboratory activities for high school students, exposing them to the excitement and challenge of science.

Matt’s research group seeks to better understand how the fundamental components of the Earth system—the atmosphere, biosphere, hydrosphere and solid Earth—interact to regulate the chemical composition of the ocean-atmosphere system and how this has changed over the past billion years. He is thrilled to have two new scientists join his group: Chris Junium and Brian Kristall.

Chris, who recently completed his Ph.D. at Pennsylvania State University, was awarded an Agouron Institute Geobiology Fellowship to explore the relationship among the Neoproterozoic C, S and N cycles, ocean redox, and biology. Brian received his M.S. from the University of Washington and plans to examine the relationship between volcanogenic massive sulfide deposits and ocean chemistry.

Additionally, seasoned graduate students Derek Adams, Maya Gomes and Jeremy Gould and faculty colleague, Brad Sageman, have been working with Hurtgen to explore a new hypothesis that highlights the important and previously unappreciated role the sulfur cycle plays in regulating the global carbon and oxygen cycles. Key aspects of this hypothesis were published in *Nature Geoscience* and served as the foundation for the CAREER proposal. This work has important implications for understanding the processes enhancing marine nutrient recycling and photosynthesis, driving short-term (<1 million years) oxygen deficiencies in the deep ocean, and facilitating long-term atmospheric oxygen accumulation and CO₂ drawdown.



Matthew Hurtgen atop the Mackenzie Mountain Range in the Northwest Territories of Canada

Jacobsen Receives PECASE Award at the White House

In January, Steve Jacobsen received the Presidential Early Career Award for Scientists and Engineers (PECASE) at a White House ceremony. This is the most prestigious honor that an early career scientist can receive and a source of great pride for the department.

Jacobsen was among those selected for the award from the entire field of 2009 NSF-CAREER awardees. He was selected based on the high quality and breadth of research that he conducts. Students in Jacobsen’s Mineral Physics Laboratory are working on a wide range of projects. Julia Swanson is investigating the physical properties of thaumasite, an alteration mineral thought to be responsible for sulfate attack of Portland cement. Yun-Yuan Chang is measuring the influence of water on the compressibility of mantle minerals at the Advanced Photon Source of Argonne National Lab, and Kim Adams is conducting infrared-reflectivity measurements of solid and liquid methane for application to interpreting possible hydrocarbon lakes on Saturn’s largest moon, Titan.



Jacobsen (top right) receives the PECASE award in January 2010.

EPS Participates in Community Outreach

Project EXCITE

Once again this past February the department was taken over by a group of third and fourth graders for a stimulating educational outreach program known as Project EXCITE. The goal of the program is to bridge the academic gap that exists in the minority community. This opportunity gives professors and graduate students the chance to work together in creating fun, interactive lessons for elementary aged students.

This year students learned all about our climate by creating global warming in a jar. Leaf edges were examined in order to determine the average local temperature. Students created their own earthquakes by jumping around and then examining their seismogram. Rocks were analyzed to determine their mineral content. Students even had the opportunity to virtually visit Mars!

Project EXCITE has been a wonderful opportunity not only for the department, but also for the young students developing an interest in science. We are pleased to provide ongoing support for this successful program developed by the Northwestern Center for



Graduate students Greg Lehn and Allison Baczynski engage eager learners in a Project Excite session.

Talent Development. Success is now being realized with the first students from the program matriculating at prestigious universities - one is even currently attending Northwestern.

Jr. Science Cafe

Graduate students Trevor Bollmann, Miguel Merino, and Emily Wolin, as well as undergraduate student Joseph Walkowicz joined Suzan van der Lee in a Junior Science Cafe presentation to Evanston

middle schoolers held at the Evanston Public Library. The presentation was entitled *EarthScope and earth-phones: What seismic waves can tell us about the evolution of a continent* and proceeded informally and interactively. Field photos, slinkies, geophones, SeisMac, EarthScope stickers, and paper handouts were shared with the audience. The presentation highlighted field seismology and drew upon the USArray-related summer experiences of the students present (see story page 5).

EPS Welcomes and Goodbyes



Visiting Assistant Professor, **Dr. Yarrow Axford**, joined the EPS faculty last Spring. Axford, a paleolimnologist, was previously a Research Associate

at the University of Colorado's Institute of Arctic and Alpine Research. Axford recently received an ISEN booster grant to extend her research on the sensitivity of the Greenland Ice Sheet to climate change, as well as NSF funding to study the Holocene climate history of the Peruvian Andes.



Post Doctoral Researcher, **Dr. Christopher Junium**, landed at Northwestern last January with a very prestigious Agouron Institute Geobiology

Fellowship. Chris now works with Professor Matt Hurtgen to explore the relationship among the Neoproterozoic C, S and N cycles, ocean redox, and biology.



Shelley Levine joined EPS in August as Financial Assistant. After many years in advertising, she's thrilled with the transition to a university setting and the EPS department.



Zhaofeng Zhang came to EPS to serve as the Radiogenic Isotope and Aqueous Geochemistry Lab Manager. Zhaofeng was previously a visiting scholar and a post-doc in the Geology Department at University of Illinois, Urbana-Cham-

paign.

We said goodbye to **Tiffany Adams**, former Financial Assistant, who accepted a position at the Illinois College of Optometry, **Sylvia-Monique Thomas**, post-doc of Craig Bina and Steve Jacobsen, who accepted an Assistant Research Professor position at the University of Nevada, Las Vegas (High Pressure Science and Engineering Center), and **Jong-Sik Ryu**, post-doc of Andy Jacobson, who will be senior researcher in the the Division of Earth and Environmental Sciences, Ochang Center, Korea Basic Science Institute. **Sung-Joon Chang**, post-doc of Suzan van der Lee, is going to the University of East Anglia in Norwich, UK as a senior research associate to do research about whole mantle structure derived from global and regional seismic data and seismic anisotropy at the core-mantle boundary.

A Summer USArray Data Processing Short Course

Twenty-three seismology graduate students and post-docs participated in the USArray Data Processing short course held August 25-29 at Northwestern University.

This is the second time that the course has been offered to address opportunities and challenges in USArray data processing and present a current practices forum.

Participants were inspired to further the development of new strategies and tools that deal effectively with the enormous volume of USArray seismograms.

Student group projects were presented on the last day of the short course, which took place in the university's Mac Lab in the Main Library and was organized by Suzan van der Lee along with colleagues from Indiana University, IRIS-USArray, and the University of Southern California. As in 2009, the 2010 course was sponsored by the EarthScope program of NSF and IRIS.

Joseph Walkowicz holds an antenna to measure the location's cell signal strength, while Emily monitors that on screen.



EPS Participates in USArray and EarthScope Projects

During the 2010 summer, undergraduate student Joseph Walkowicz and graduate student Emily Wolin set out on a road and field trip to find the best sites in Illinois for the installation of 21 broadband seismic stations of the Transportable Array (TA). The TA is a suite of 400 seismometers that “rolls” across the USA over 10 years, measuring ground motion from distant earthquakes at about 2000 sites. The stations remain in place for about two years. This student and outreach opportunity came to NU through a subcontract from USArray.

In August, Ms Wolin set out again, this time accompanied by just-graduated senior

Colleen Moore and graduate students Trevor Bollmann and Miguel Merino to find sites for 40 temporary seismic stations of a Flexible Array (FA) research project SPREE (Superior Province Rifting Earthscope Experiment). They split into two teams scouting in northwest Wisconsin and central Ontario, respectively. In the 2011 spring and summer NU will install seismic equipment at those and other sites in Minnesota, in collaboration with SPREE partners at Washington University, the University of Minnesota, the University of Manitoba, and the University of Quebec at Montreal, as well as the PASSCAL Instrument Center of IRIS. NU Principal investigators Van der Lee, Stein, and Jurdy say that this FA experiment, along with the passage of TA through Minnesota and Wisconsin, will allow us a tremendous opportunity to investigate the healing of tectonic activity associated with

the Mid-Continent Rift (MCR), or in other words why there's no ocean between Wisconsin and Minnesota since about a million cubic km (200 Lake Michigans) of basalt were deposited along the MCR around 1.1 Ga.

The TA and FA are part of the USArray component of Earthscope and are possible through the generous cooperation of landowners and park rangers. EarthScope is a national program, funded by the National Science Foundation, that aims to study the evolution of the North American continent as well as the processes that cause earthquakes and volcanism. To this end, thousands of geophysical instruments are deployed across the US, which include dense arrays of GPS receivers, strainmeters, magnetotelluric instruments, and broadband seismometers, including the TA and FA components of USArray.

Faculty Highlights

Yarrow Axford is a Quaternary geologist who joined the department as a Visiting Assistant Professor last September. Her research uses lake sediment records to reconstruct Holocene and current climate change in the Arctic, including near the margin of the Greenland Ice Sheet and in the tundra environments of southwest Alaska. A new NSF-funded project will apply similar methods toward understanding the little-known climate history of the Peruvian Andes.

Patricia Beddows After leading another wildly successful spring fieldtrip to the Yucatan, Beddows headed up a National Geographic Expedition in the jungle of Belize near the Guatemalan border, along with archeologist Lisa Lucero (PI) of the University of Illinois Urbana-Champaign. Diving the "Sacred Pools of Cara Blanca," she focused on the subaqueous geoarcheology and Holocene sedimentary records of environmental change.

Craig Bina While continuing his work on processes in subduction zones and the deep mantle below 400 km, Craig Bina started to focus on some shallower regions this spring. He began pursuing mineralogical interpretations of oceanic seismic anisotropy with colleagues in Prague, Czech Republic, as well as of the elusive upper mantle X-discontinuity with colleagues in Frankfurt, Germany.

Neal Blair's research has focused on the behavior of organic carbon as it travels across Earth's surface. In a recent study, he and colleagues have tracked organic matter from the uplands of New Zealand's Waipaoa and Waiapu Rivers to burial on the continental shelf and slope. The marine sedimentary record of these dispersal systems has revealed tectonic events, possible changes in climate, and the impact of humans. The Blair group is also studying microorganisms, such as soil fungi, as potential sources of recalcitrant macromolecular carbon. These materials may be important sources of sequestered carbon in soils and sediments.

Matthew Hurtgen (see story on page 3)

Steve Jacobsen (see story on page 3)

Andrew Jacobson uses isotopic methods to study climate change. Recent work funded by NSF and the Packard Foundation employs calcium isotopes to understand Earth's ancient and modern carbon cycle. Members of his research group—Joel Moore, Jong-Sik Ryu, and Greg Lehn—are leading projects in New Zealand, Greenland, and Alaska, respectively. Jacobson was one of four researchers from across the country selected by the American Geological Institute (AGI) to speak in Washington, D.C. last April about the importance of supporting basic scientific research with federal funds. Meeting with political representatives from both Illinois and Alaska, Jacobson spoke about his Arctic climate change project, as well as his newly initiated Chicago CO₂ Project, an extensive effort to measure the concentration and sources of CO₂ in Chicago's atmosphere. He also spoke with Alaskan representatives about how the melting of permafrost could potentially affect the Trans Alaska Pipeline, which requires frozen ground for stability.

Donna Jurdy's research is on planetary surfaces to understand their tectonics and evolution. She continues work on Venus with Paul Stoddard analyzing the topography of features, such as coronae and chasmata, and comparing with well-known terrestrial features that may be analogues. In addition, she and graduate student Kim Adams study Titan, a most enigmatic satellite of Saturn. They are examining the distribution and sizes of pits, abundant depressions on Titan's surface.

Abraham Lerman, co-author of the recently published *Carbon in the Geobiosphere*, is studying the interactions of the global climate change with the biogeochemical cycles of life-essential elements. The coupled carbon-nitrogen-phosphorus-silicon biogeochemical cycles interact with the changes in the atmosphere, land, and ocean, caused by natural and human processes, and in turn modify them. Lerman, along with his collaborators and graduate students, have identified the times of reversal in



Andrew Jacobson (left) explains his research to U.S. House Representative Vern Ehlers.



Craig Bina ascends Mount St. Helens in Skamania County, Washington.



Beddows' team of 7 divers used new methods to recover three-meter-long cores of Holocene sediments. In the process, they discovered the largest underwater cave in Belize, underwater...



At the 2010 Graduation Reception, Francesca McInerney (left) poses with advisee Michael Philben and his mother.



Emile Okal (right) interviews an elderly witness of the 1945 Makran Tsunami, Konarak, Iran.



... springs, and giant sloth fossils. The National Geographic News video "Diver Vanishes," reached the second highest level of viewership in 2010.

the air-sea CO₂ exchange of the shallow coastal and open ocean, the limiting role of phosphorus in biological production on land and control of the atmospheric CO₂ concentration, and the expected future hardships of the calcifying and silicifying organisms in the coastal ocean due to an increase in seawater acidity and changes in the input from land.

Francesca McInerney's research focuses on plant responses to climate change in modern and ancient ecosystems. She and her students Rosemary Bush and John Kapnick examine whether the abundance and isotopic signature of leaf wax lipids vary among plant groups and with environment. Together with students Allie Baczynski, Mike Philben and Alexa Socianu, she studies the global warming event that occurred 55 million years ago. A video on her work is featured at the Washakie Museum in Worland, WY, and available at <http://www.youtube.com/watch?v=C9bfVKkqloA&feature=search>.

Emile Okal participated in the field surveys of two major tsunamis, the Samoa event of 2009 (in American Samoa, Samoa, and Tonga), and the Chilean event of 2010 (in the Marquesas Islands). During the latter, he happened to be visiting the warning center in Tahiti, where he had a night-long hands-on experience in hazard management, leading to evacuation in 68 local islands. He later was invited by UNESCO to lecture in Iran and Pakistan in preparation of future field work to identify and map potential historical tsunamis on their Indian coastlines.

Brad Sageman (Chair) is a co-author on seven scholarly articles with a 2010 publication date. Two of these are lead-authored by colleagues in cognitive science and concern a geoscience education collaboration to study spatial intelligence. The other papers present results from various research projects focused on Cretaceous rocks of the Western Interior basin. The major objective of most of these studies is to improve understanding of the biogeochemical dynamics of the Late Cretaceous "hyperthermal"—one of the warmest times in Earth history. Improved understanding of the controls on, and

feedbacks within the greenhouse ocean-climate system that characterized this period will provide important information about possible future ocean-climate dynamics. The newest project that Brad has started is an NSF-funded collaboration with colleagues at the University of Wisconsin to revise and improve the geologic time scale for the Cretaceous. Integration of Ar-Ar and U-Pb dating techniques with floating astrochronologies will allow levels of geochronologic resolution approaching 0.1 myr—a significant advance with major implications for deep time climate studies.

Seth Stein has completed a book *Disaster Deferred: How New Science is Changing our View of Earthquake Hazards in the Midwest*. Coinciding with the 200th anniversary of the New Madrid earthquakes, the book is based on new results that have emerged from studies at Northwestern and elsewhere. It revisits these earthquakes, the legends that have grown about them, and the predictions of doom that have followed in their wake. Detailing how limited scientific knowledge, bureaucratic instincts, and the media's love of a good story have exaggerated these hazards, the book explains how new ideas and data are painting a very different and much less frightening picture of the future.



Suzan van der Lee continued her research into the mechanics and evolution of continents and plate tectonics. While graduate student Simon Lloyd and post-doc Sung Joon Chang are finishing up their research on the South American continent and former Tethys Ocean's margins, respectively, graduate student Xiaoting Lou continued his EarthScope-funded research on North America. Along with Stein, Jurdy and colleagues at Wash U, the U of MN, the U of Manitoba, and UQAM, Van der Lee embarked on a new research project, named SPREE (Superior Province Rifting Earthscope Experiment), which targets the 1.1 Ga old Mid-Continent Rift with seismic instruments in the field and computer-based data analysis. The rift is aseismic at present, and accompanied by the largest gravity anomaly between the North-American margins. Beginning graduate student Trevor Bollmann

Faculty Highlights *continued from page 7*

already completed scouting field work and knowledge assembly for SPREE (see elsewhere in this issue), while Jessica Lodewyk began to learn how to help Chang investigate the implications of his joint tomographic image for the absence of intermediate-depth seismicity beneath the Apennine and Zagros Mountains.

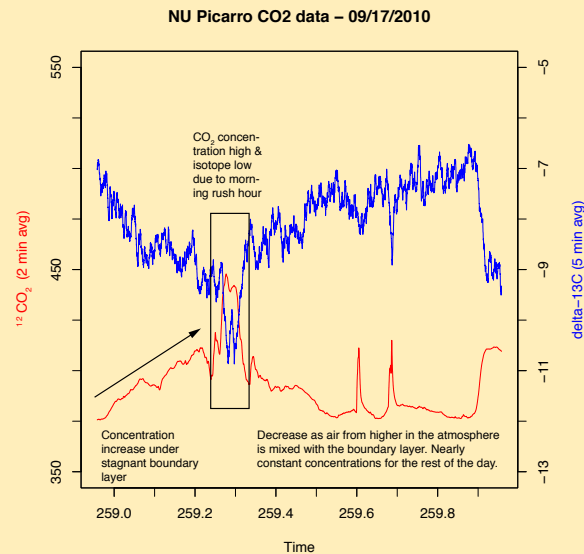
Van der Lee took advantage of the Haiti, Chile, northern Illinois, and other earthquakes of 2010 for her fall-quarter freshman seminar on earthquakes, as well as for Project EXCITE.

Early in 2010, Van der Lee was elected Secretary of AGU's Seismology section by the AGU membership. She will be happy to convey your comments to the AGU leadership.

In addition to continued participation in specialty workshops, Lou, Chang, and Van der Lee gave five talks and presented one poster at the 2010 fall AGU meeting while Lloyd presented his work at the joint assembly earlier this year in Iguas-su, Brazil. Van der Lee also continues participation in numerous committees within the seismological community and was featured on NPR in Gabriel Spitzer's "Clever Apes".

EPS, ISEN & the Climate Change Symposium

Two years ago the university established the Initiative for Energy and Sustainability at Northwestern (ISEN). ISEN'S mission is to promote research and education concerned with the interrelated issues of fossil fuel vs. alternative energy use, environmental impacts due to fossil fuel emissions (mainly climate change), and the development of sustainable practices in all sectors of the global economy. Sustainability in this context spans a broad array of disciplines including law and economics, political science and sociology, chemistry, material science and civil/environmental engineering, and many others. The earth sciences play a central role



Joseph Walkowicz attaches the intake and filter for the Picarro to the NU van.

Taking Measure of Chicago's Urban Metabolism

by Joel Moore

One year ago, I would not have expected to find myself and Joseph Walkowicz (EPS undergraduate, 2011) driving the streets of Evanston and Chicago measuring the levels and sources of CO₂ in our local atmosphere. This new direction for my research is part of a project I am spearheading along with my postdoctoral advisor Andy Jacobson, which has been funded by the Initiative for Sustainability and Energy at Northwestern (ISEN), the David and Lucile Packard Foundation, the Weinberg College of Arts and Sci., the McCormick School of Eng. and Applied Sci., and the Vice President for Research.

With Joseph and other NU undergraduates, we are using a novel method called cavity ring down spectroscopy to quantify the concentration and carbon isotope composition of atmospheric CO₂. By measuring CO₂ concentrations, we can assess the role that an urban center like Chicago plays in emitting CO₂ to the global atmosphere, and by measuring the carbon isotope composition of this CO₂, we can fingerprint CO₂ sources, such as petroleum and natural gas burning. We will post the information on the internet in real time as it is collected to begin producing a high-resolution record for the City of Chicago.

in this equation as they are intimately involved in both the fossil fuel industry, as well as the science of global climate change. As the world attempts to move toward a low or zero carbon economy, cleaner hydrocarbons such as natural gas will become crucial transitional fuels. For this reason, there is currently a "boom" in shale gas exploration and production and work by department researchers on gas shales has made an impact in this field. Similarly, a critical component of climate science is research on the past behavior of the Earth's climate, and about half the research in our department focuses on paleoclimate studies.

The department has a strong partnership with ISEN. Department chair Brad Sageman serves as ISEN's Associate Director for Education and co-teaches a class for ISEN titled "Sustainability: Science, Policy and Ethics."

In addition, many EPS researchers have been funded by ISEN on small projects related to sustainability. Lastly, ISEN co-sponsors an annual symposium on climate change that our department organizes and hosts. This year the keynote speaker was Dr. Ralph Keeling whose father, Charles, started the Mauna Loa CO₂ observatory, which Ralph continues to manage (Keeling Sr. was an NU PhD in Chemistry). Some of the other speakers included Dr. Mark Pagani of Yale, Dr. Sally Benson of Stanford, Dr. Liz Moyer of the University of Chicago, Dr. Kimberly Gray of NU's Environmental Engineering Department, and Dr. Yarrow Axford, a visiting professor in our department. The event has been a great success for two years running and we will continue to hold it in the future.

Graduate Student News

Derek Adams is a 5th year student whose work focuses on reconstructing ancient marine redox surrounding Oceanic Anoxic Event 2 in the Late Cretaceous using S-isotopes and Fe-speciation measurements. His paper, recently published in *Nature Geoscience*, explores how volcanically induced changes in seawater sulfate levels triggered a biogeochemical cascade culminating in OAE2. In Summer and Fall 2009, Derek interned in the energy industry and has accepted a position with ExxonMobil after completion of his PhD in Spring 2011

Kim Adams has published two papers in a special publication of *Planetary and Space Sciences* entitled *Titan Through Time: Formation, Evolution and Fate*. The papers are *Pit Distribution in the Equatorial region of Titan* co-authored with Donna M. Jurdy, and *Visible and near-infrared reflectivity of solid and liquid methane: applications to the hydrocarbon lakes on Titan* co-authored with Steve D. Jacobsen, Sylvia-Monique Thomas, Zhenxian Liu, Maddury Somayazulu, and Donna M. Jurdy. She is continuing her research on low temperature reflectivity of hydrocarbons, with application to the outer solar system surfaces, at Brookhaven National Laboratory this November 2010 and February 2011.

Allison Baczynski is thrilled to have passed her qualifying exam in April! She spent July in the Bighorn Basin, Wyoming collecting ancient soil samples that record the Paleocene-Eocene Thermal Maximum (PETM), a period of large-scale global warming that occurred ~55.8 Mya. During the upcoming year she will analyze these samples in order to reconstruct terrestrial paleohydrology across the Paleocene-Eocene boundary, and presented the results of this work at AGU in December.



Richard Barclay defended his dissertation, *Testing the Driving Mechanisms for Ocean Anoxic Event 2 (94Ma) Using pCO₂ Estimates*

and Carbon Isotopes Derived from Fossil Plant Material in the Dakota Formation of Southwestern Utah, and anticipates graduation in June 2011.

Trevor Bollmann has previously done work on earthquake seismology in the area around Sumatra, Indonesia and will be working with Suzan Van der Lee on a seismic tomography project.

Rosemary Bush (see page 2)

In the past year, **Yun-Yuan Chang** has attended COMPRES and SSAA/NNSA meetings and presented her poster on superhard materials, *Developments in GHz-ultrasonic interferometry for elasticity studies in geophysics and materials science: application to diamond*. She also passed her qualifying exam and will continue her research on elastic properties of minerals and materials. At the AGU meeting, she presented her experimental result on the compressibility of Fe-bearing hydrous wadsleyite.

Second-year student **Laurel Childress** has continued her previous investigations of source to sink paths for organic matter (carbon and nitrogen) by incorporating methods for determining lignin quantity and composition in continental shelf cores. Coupled with terrestrial soil and riverine mud samples this data can serve as a proxy for environmental change in the Waipaoa River sedimentary system, New Zealand. Potential forcing mechanisms for floral change include volcanic eruptions and anthropogenic deforestation.

Carl Ebeling presented work supported by his NSF Graduate Research Fellowship at three conferences; his abstract, entitled *Extending the North Atlantic Hurricane Record Using Seismic Noise* was chosen for a press release at the October Geological Society of American meeting. His first paper based on this work, co-authored with Dr. Seth Stein and entitled *Seismological Identification and Characterization of a Large Hurricane*, will be published by the *Bulletin of the Seismological Society of America* in February, 2011. Carl was active in fieldwork related to the large Maule (Chile) earthquake of February 27, 2010. In early March he participated

in an international field survey of the Chilean coast affected by the tsunami, and in July was involved with servicing a large network of seismometers in Chile specifically installed to monitor activity related to the February earthquake.

First year student **Renee French** has been discussing Mars magnetization with NASA scientists as a first step in beginning her research on this topic with Professors Donna Jurdy and Seth Stein.

Maya Gomes is a NASA Earth and Space Science graduate fellow who examines sulfur isotope fractionation in low sulfate systems in order to better understand how the chemistry of Precambrian low-sulfate oceans changed in response to the early evolution of life on Earth. She also completed the 2010 International Geobiology Course where she studied lipid biomarkers in microbial mats in hot springs at Yellowstone National Park.

Jeremy Gouldey has been studying the relationship between carbon and sulfur during the interglacial period between the two Snowball Earth glaciations, and recently published the paper *Strontium and carbon isotope stratigraphy of the Llandovery (Early Silurian): Implications for tectonics and weathering* in the journal *Palaeogeography, Palaeoclimatology, Palaeoecology*.

Young Ji Joo (see page 2)

Brian Kristall is investigating the evolution of ocean water chemistry during the Precambrian. In particular he will be looking at the sulfur system within the Earth's early oceans using ancient hydrothermal systems (volcanogenic massive sulfide deposits).

Greg Lehn (see page 2)

Dan (Darcy) Li is working with Prof. Lerman modeling the biogeochemical cycle of Si. This work extends previous modeling of anthropocene C-N-P cycles to study how terrestrial uptake and outflow of Si to the coastal zone have changed and subsequently drove marine primary production and nutrient cycling in the

Graduate News *continued from page 9*

ocean, especially by human perturbations. She is also working with Professor Andy Jacobson on a reactive transport model to investigate tectonic and climatic controls on weathering fluxes on a regolith profile scale.

Jessica Lodewyk is currently working on a project with Professor Suzan van der Lee investigating mechanisms of intermediate depth earthquakes underneath the Apennine Mountains and the Zagros Mountains.

Xiaoting Lou measures teleseismic P and S relative delay times from IRIS PASSCAL and EarthScope USArray data and inverts for velocity variations of North American mantle. His data suggests that the mantle beneath the US east of the Rocky Mountains is at least as heterogeneous as the mantle beneath the US west of the Rockies. Relative contribution to these delays of the deep upper mantle is stronger in the east.

Simon Lloyd received the Horace A. Scott Graduate Award for Outstanding Research for the year 2009-2010. This award is for excellence in research. His paper, *Moho map of South*

America from receiver functions and surface waves, was published by the Journal of Geophysical Research, and Lloyd presented a talk about his research at the Meeting of the Americas in Brazil last August.



Miguel Merino is exploring the rifting process in different regions, working to identify all that is known about rifts, and trying to develop new theories for their formation. Analysis of different intraplate seismic zones has been a large focus of this past year, trying to understand the limits of catalogs and magnitude scales, and the sources of bias in these records. The work has been exciting, to say the least.

Karen Tekverk did her undergraduate thesis analyzing the potential for early life in the Abitibi Greenstone Belt in Quebec. At Northwestern, Karen is developing projects in geophysics while maintaining her interest in environmental science.

Joshua Townsend is interested in the makeup of the Earth's mantle. Using diamond anvil cells and lasers, minerals can be subjected to very high pressures and temperatures, reproducing mantle-like conditions in the laboratory. X-ray diffraction of samples inside the cell reveals the atomic structure of the sample at mantle pressures and temperatures. This is a much easier way of investigating what the Earth is made of than trying to dig a hole 100 miles deep!

Emily Wolin worked with Prof. Stein studying the aftershocks of the 1929 Grand Banks and 1933 Baffin Bay earthquakes. At the SSA Annual Meeting, they presented their results showing that aftershocks from both earthquakes continue today. Supervised by Prof. van der Lee, Wolin and Joseph Walkowicz scouted 21

sites for EarthScope's Transportable Array seismometers. And later, Colleen Moore and Wolin scouted 22 additional sites in Wisconsin and Minnesota for Northwestern's SPREE project.

Undergraduate Research

John Kapnick *n-Alkanes as Chemotaxonomic Indicators for Ferns*. Advisor Francesca McInerney. **Jessica Kunke** *Investigating the Influence of Climate, Prices, and Economic Activity and Observed changes in Evanston Green House Gas Emissions, 2005-2008*. Advisor Andrew Jacobson. **Colleen Moore** *Earthscope, SPREE, and The Mid-Continent Rift, an exercise in mapping and beyond*. Advisor Suzan van der Lee. **Michael Mounier** *Sulfur isotope evidence for low marine sulfate concentrations and increased volcanic activity prior to Ocean Anoxic Event 2*. Advisor Matthew Hurtgen. **Michael Philben** *Application of compound-specific isotope geochemistry to constrain the location of the Paleocene-Eocene Thermal Maximum in the Williston Basin*. Advisor Francesca McInerney. **Julia Swanson** *Pressure induced phase transition of thaumasite, a secondary mineral responsible for sulfate attack of Portland cement*. Advisor Steve Jacobsen. **Alan Wong** *Ca isotope geochemistry study of soils from the New Zealand Southern Alps*. Advisor Andrew Jacobson. **Teresa Wong** *Super Earths: What would giant Earth-like extra-solar planets be like?* Advisors Donna Jurdy, Seth Stein.

Extreme Departmental Comraderie *by Laurel Childress*

During the past year there have been many social events developed for and offered to graduate students and others in the department. Weekly events included typical trips to Prairie Moon Restaurant and Bar for happy hour. In addition, more unique weekly events have included Cool Kids Lunch where all students, post-docs, faculty, and staff are invited to gather in a classroom and relax together while sharing their meal. Random celebrations such as SuperBowl and holiday parties are also still a favorite amongst graduate students in the department.

For those more inclined toward physical activity, a group of runners has formed and participated in local runs ranging from the "Doughnut 5K" on the lakefill, to the Monster Half Marathon, and even the Chicago Marathon. Other more team oriented events have included a soccer game against the Mechanical Engineering Depart-

ment and intramural volleyball as 'Team Baraboo Court-side'. Faculty members Brad Sage-man and Craig Bina were even willing to lend their bump and spike skills. Finally, the most extreme of our social events is the Polar Plunge. In January 2010 ten brave graduate students and post-docs braved the waters of Lake Michigan to become the inaugural members of the EPS Polar Bear Club. Students who lacked determination last year will have another chance to join in the Winter 2011 quarter.



Alumni News



Stefan Jensen with bicycle and gear.

The publication *JGR-Solid Earth*, invited EPS Adjunct Professor **Hans Weertman** to serve as an associate editor.

Hassan A. Babaie, (Ph.D. 1984) Georgia State University, has been elected as a 2010 GSA Fellow. GSA Affiliations: Southeastern Section; International Section; Structural Geology and Tectonics Division; Geoinformatics Division. He was recognized at the GSA Presidential Address and Awards Ceremony 30 October, at the Colorado Convention Center in Denver.

Erin K. Beutel (Ph.D. 2000) Associate Professor of Geology at the College of Charleston, directs the SC Earthquake Education and Preparedness program, funded in part by the South Carolina Emergency Management Division.

Heather Bedle (Ph.D. 2008) has drilled five wells for Chevron.

Michael Churkin (Ph.D. 1961) visited the department last October to discuss his 30+ year career with the Geological Survey, his work in the Arctic and as an exchange scientist in Russia.

Stefan Jensen (BA 2009) completed an 8-month, 6,000 mile pedal bicycle trip from Mexico to Argentina this past year. As a volunteer for a Chicago-based non-profit, Reach the World, he wrote weekly social studies and science curriculum about the trip (including how volcanoes and canyons form, of course) for 3000+ underserved Chicago Public School students. He spent this past summer working as a field assistant and camp cook for Prof. Francesca McInerney's Bighorn Basin field camp.

Dave Larue (Ph.D. 1979) is a Consulting Earth Scientist for the San Joaquin Valley Business Unit of Chevron North America Exploration and Production Company, based in Bakersfield, California. He lives in Newport Beach, California, and spends 5 days a month in Bakersfield. He

studies the numerous giant fields in the San Joaquin Valley, including Coalinga, Kern River, Midway Sunset, San Ardo, Lost Hills, Cymric and others, providing stratigraphic guidance, reservoir characterization and earth modeling solutions. He continues to publish on such topics as reservoir connectivity and tortuosity, with implications for recovery.

Robert C. Nugent (Ph.D. 1966) passed away June 2006. He retired from Exxon Mobil as a research scientist. He taught at SUNY Oswego for twelve years and served as Chair from 1968-1980.

Michael Philben (BA 2010) joined the Graduate Program at the University of South Carolina, Fall 2010.

Paul Richard Stoddard (Ph.D. 1989) has returned to teaching/research duties after a 5-year stint as President of the Faculty Senate/Executive Secretary of the University Council at Northern Illinois University. He is continuing his work with Donna Jurdy (NU Earth & Planetary Sciences) on Venus, as well as looking at Enceladus (moon of Saturn) and our own Moon. WPSY-TV, of Plano, IL, interviewed Professor Stoddard for a science show, where he discussed the M3.8 2010 IL earthquake.



Lab facility photographs by Anthony (Tony) May, www.mayphoto.com

Renovating Hogan

Our re-envisioned interior Hogan Building space, a classic architectural building constructed by Walter Netsch, includes sweeping hallway spaces, inviting impromptu conferencing and exchange of material and ideas between diverse working groups.



As seen here in the Organic Geochemistry Lab, the ample exterior perimeter of this multi-faceted building allows for continuous work flow between prep bench, fume hood, microwave digestion, solvent extraction, and ultimately the analysis of compound specific isotopic values of lipids from modern plants, alongside the well preserved fossilized floral remnants from the Paleo-Eocene Thermal Maximum and other interesting target events in Earth History.

Game Changer *continued from cover*

construction phases of the project. Other faculty members who will manage labs in the facility, Cesca McInerney, Matt Hurtgen and Neal Blair, were intimately involved in the project. But the largest share of credit goes to Assistant Chair Trish Beaddows, who has functioned as the de facto Project Manager, shepherding this complex project every step of the way.

It has been a long haul for Beaddows. From working to ensure that researchers' needs were correctly translated to architects and contractors, to the final completion of all work orders, she has been the prime mover of the project. "As you walk into the lab you are impressed with the well-designed and modern lab space," says Beaddows. "If you look carefully into the nooks and crannies, you will notice up to 16 layers of infrastructure. Electrical, mechanical, heating, ventilation, alarm systems, gas lines, water supplies, drainage, and about eight others. There is an intensive jigsaw puzzle of infrastructure in support of these laboratories."

Faculty and students have already begun to occupy and conduct research in three of the five new lab modules, and the two remaining labs should be online early in 2011. Three dedicated lab managers oversee the labs, sometimes 24/7. Long-time Research Technician, Petra Sheaffova, will run the sleek new rock prep facility—a huge step up from the basement rock crushing room fondly known as "Hades" (due to the heat, condensation and peeling paint). Kelly Peeler joined the staff to manage the Stable Isotope Lab, the first of the lab facilities completed, and Zhaofeng Zhang joined the department to run the Radiogenic Isotope Lab.

Dr. Francesca McInerney especially likes the facility's common hallway with large glass windows. "I think interlab collaboration is going to happen more up there than in many labs across the Northwestern campus. People will see someone doing something in the lab and be curious about it and say, 'I saw you working. What were you doing up there?'"

Another benefit of ILEPS, according to Department Chair, Brad Sageman, is the training in analytical methods that students will receive. "The facility is unique - I know of no other that integrates these different components in such an intimate way, fostering a rich interdisciplinary environment. The department has had a long history in geochemistry and mineralogy that was much more focused in numerical and theoretical approaches. This facility will establish EPS as an analytical powerhouse. It is a game changer," says Sageman.

Housing two state of the art Thermo Finnegan Delta V isotope ratio mass spectrometers, with two dual inlets and a suite of continuous flow inlet capabilities including GC, EA, TC/EA, and Gas Bench, we are analyzing a diverse range of samples prepared by labs throughout ILEPS as well as external collaborators, and producing results of the highest quality for the stable isotopes of C, N, H, O, and S.



Glancing upwards as you walk into the Sedimentary Geology Lab, you can appreciate the complex network of ducts, liquid and gas lines, and electronic controls all supporting this multifunctional space. Professors Hurtgen and Sageman focus on the analysis of iron, sulfur, carbon, phosphorus using acid digestion extraction lines in the 5 fume hoods. Benchtop "dueling" coulometers facing each other provide for most efficient sample processing. In the Aqueous Geochemistry alcove to the left, Prof. Jacobson's group uses ICP-OES and IC to analyze a wide range of elements.



Phase II of construction includes Jacobsen's Mineral Physics Laboratory. The new lab features specialized areas for spectroscopy, ultrasonic testing, and X-ray diffraction, expanding his ability to experiment with high pressure-temperature conditions using diamond-anvil cells.

A jewel in the ILEPS concept for all the labs is the Rock Preparation and Collections suite, with well lit sample examination tables, and upgraded facilities for slicing, slabbing, cutting, crushing, powdering, and otherwise rendering down earth materials for physical-chemical analysis. Integrated overhead storage houses our expanding field equipment needs.



Lab facility photographs by Anthony (Tony) May, www.mayphoto.com



WEINBERG
COLLEGE OF
ARTS & SCIENCES