

# epicenters

The Newsletter of the Department of Earth and Planetary Sciences at Northwestern University | 2012

JUDD A. AND MARJORIE WEINBERG COLLEGE OF ARTS AND SCIENCES



## NEW HOME

### Locy Hall, August 21, 2012

Men in blue shirts bearing a moving company logo delivered 300 flattened boxes onto the first, second, and third floors of Locy Hall. One of the movers looked at the 150-pound fluorite display in the stairwell, laughed, and said, “We’re moving rocks!” A floor away, Professor Donna Jurdy said, “I am taking this.” She motioned to the antique, black slate on her wall with its hardwood shelf for chalk, a vintage item for the minimalist modern space we will occupy. Packed boxes inside Professor Bina’s third-floor office wait. “I’m worried I’ll need something at the bottom of one of those. At least I didn’t pack my fall course materials.” It is the end of an era for the Department, and it’s winding down one box of files, one drawer of rocks at a time.

This is the third move for the Department of Earth and Planetary Sciences. For 90 years (1869-1958) geology courses were taught in University Hall, although the department was not formed until 1892. In the fall of 1958, Geological Sciences moved to Locy Hall, according to the *Daily Northwestern* story, “Reconstruction at Swift Moves 5 Departments,” dated 7/11/1958. Alumnus John Snyder (Ph.D. 1957) returned to NU in the summer of 1959 to teach a course for

the Department, and recalled feeling surprised by the move. John submitted a story, “The Queen Interrupts,” which resulted from a call for alumni news. While proctoring an exam in Locy that summer, he spotted a unique sight: a flotilla bearing Queen Elizabeth II from the United Kingdom to visit Mayor Daley in Chicago. This was prior to the construction of the Lakefill Campus, when there was a small pier on the beach visible from Locy Hall. See John’s story on the loose insert in this newsletter. But back to the present...

### Technological Institute, October 24, 2012

We are happy to report that the Department survived the move to Tech, one of the largest academic buildings in the world, which occurred just two weeks before the first day of fall quarter, although men wearing hard hats can still be found here adjusting the temperature and putting the final touches on the sleek modern space. We were ready for the Fall 2012 classes though, and Professor van der Lee’s *Seismology and Earth Structure* was the first class offered in our new home. We have Assistant Department Chair and Lecturer Dr. Patricia Beddows to thank for the smooth transition. She deftly managed the build-out of our new home seemingly minutes after serving as the project liaison on our state-of-the-art

analytic lab facility, ILEPS. All this, while leading department field trips and conducting her own underwater research in the Yucatán.

Our new home is on the second, third and fourth floors of the Tech F wing Infill. (We have elevators!) It is adjacent to a light-filled atrium which encloses the beautiful once-exterior wall of Tech, made of Lannon dolostone quarried in Southern WI and the famous Salem limestone from IN. Now we regularly bump into physicists, astronomers and engineers in the hallways. This move

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## Message From the Chair



Greetings to Alumni and Friends.

Having just returned from research leave after a term as Associate Dean, I now find myself serving as

Interim Chair for this academic year while it's Brad Sageman's turn to go on leave. We fully expect Brad to return to this post next year, but meanwhile he has a backlog of manuscripts to finish and stacks of samples to be organized and analyzed. Fortunately, he left some bits of text to get me started on this column...

By the time you read this newsletter, the end of an era will have passed. The Department of Earth and Planetary Sciences will have relocated to our new space in the Tech Infill, and Locy Hall will have passed into the hands of other Northwestern programs.

This represents the most significant change the Department has experienced in many years, and it is fair to say that many will sorely miss the "rustic charm" of our ancestral home. However, we expect that such sentiments will soon be tempered by appreciation for the benefits of the new space (see *New Home*, cover).

In the time since our last newsletter, the department has continued to progress along trends set in recent years. For example, our undergraduate enrollment keeps growing, as demonstrated by a 2012 graduating class of eight and by 26 declared majors/minors for 2013, including some stellar young scholars (see *Upcoming Earth Scientists*, page 8). Our postdocs and graduate students continue to distinguish themselves with excellence in research and publication (see *Beam on Postdoctoral Research*, below, and *Graduate Student Awards and Updates* on page 9), and our faculty continue to make significant contributions to teaching, research and service at Northwestern (see *Donna Jurdy, Female Faculty Leader and*

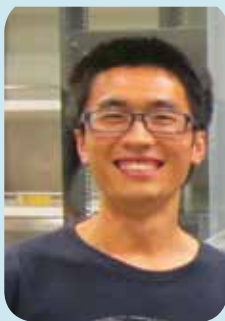
*Mentor*, page 4, and *Faculty Highlights*, page 5). The Department is extremely proud of the many accomplishments of our people, and we are thankful for the support that our alumni provide, support which helps them to succeed in their research and teaching endeavors.

In this year's Newsletter we have included a couple of articles that highlight specific research efforts of the two main branches of our department – geophysics (see *Our Solo Seismometer*, page 3) and geochemistry (*New Quaternary Sediment Lab*, page 3). We also include a section with news from alumni (page 12), and we hope you will continue to send us updates of your activities. Many thanks to all those who have sent us information, and we wish you health and happiness in 2012-13. Meanwhile, I need to finish unpacking boxes...

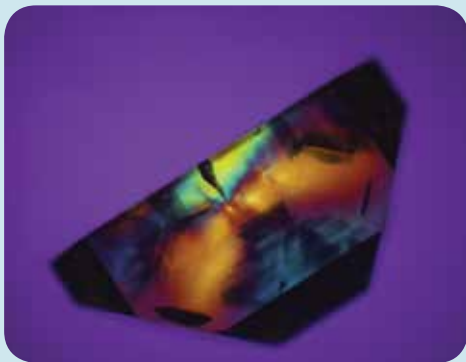
Regards,

Craig Bina

## Beam on Postdoctoral Research



In March 2012, **Dr. Xiaobing Liu** joined the department as a Postdoctoral Researcher in Steve Jacobsen's Mineral Physics Laboratory. Xiaobing earned his Ph.D. at the State Key Laboratory of Superhard Materials at Jilin University, China. Xiaobing has synthesized large single-crystals of boron-containing diamond with semiconducting properties. He is also studying newly-synthesized crystals of diamond-structured BCN, which may be the second hardest material (after diamond) ever created. Xiaobing is carrying out his research in the Mineral Physics Laboratory in Hogan and at the Advanced Photon Source of Argonne National Laboratory.



*This photomicrograph, taken in cross-polarized light, depicts a 1-mm sized, boron-doped diamond (called type-IIb diamond) grown by Postdoctoral Researcher Dr. Xiaobing Liu. The Hope diamond is the most famous type-IIb diamond, but this sample contains two-thousand times more boron than the Hope. Adding this much boron to diamond makes it semiconducting, which could revolutionize the future of electronics, owing to diamond's improved thermal properties over silicon.*



This fall, Postdoctoral Researcher **Dr. Min Sub Sim** arrived at Northwestern with a very prestigious Agouron Institute Geobiology Fellowship. Min Sub completed his Ph.D. at M.I.T. where he investigated sulfur isotope fractionation during microbial sulfate reduction. This work has important implications for reconstructing the chemical evolution of the coupled ocean-atmosphere system throughout Earth history. At Northwestern, he is working with Professor Matt Hurtgen to explore the relationship between the carbon and sulfur cycles during the Late Devonian mass extinction event.

## Toast to EPS Emeritus Professor, Abraham Lerman



On Wednesday, May 30<sup>th</sup>, at the End-of-the-Year Faculty Gathering, EPS Chair Brad Sageman and Professor Emile Okal recognized Professor Abraham Lerman for his accomplishments. Although Lerman retired on August 31, he taught *Earth's Changing Climate* during the Fall 2012 quarter.

What Chair Sageman said:

“Abe Lerman is a pioneer in the mathematical modeling of both sedimentary processes and geochemical cycling. He has a remarkable breadth of knowledge of geochemistry, rarely seen in the younger generations that follow him. His book *Geochemical Processes in Water and Sediment Environments* (published in 1978) initiated Abe’s invaluable and fundamental contributions to an understanding of rock weathering and geochemical cycling processes. The book was well ahead of its time and has stood the test of time. His edited volumes on lakes are used by everyone interested in the physical and biogeochemical processes occurring in lakes and in their evolution over time. His most recent book, *Carbon in the Geobiosphere* (2006), co-authored with former department colleague Fred MacKenzie, is one of the only texts available concerned with the full spectrum of the carbon cycle, from the basic physico-chemistry and mineralogy of

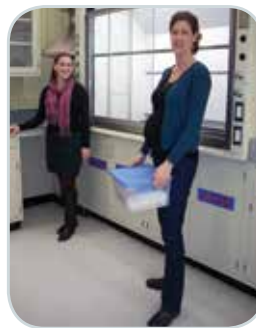
carbon and carbonate minerals, through the evolution of the global carbon cycle, up to the modern environmental problem of global warming and ocean acidification.

Abe Lerman joined the Northwestern faculty in 1971 and has been the quintessential academic in our department ever since – there is very little about which he is not knowledgeable and conversant, ranging from his own science through a wide variety of other fields, languages, and cultures. His encyclopedic knowledge of geochemistry is an invaluable resource for the Department and I am confident that retirement notwithstanding, his colleagues will persist in seeking his counsel. “

Professor Emile Okal, whose office has been next door to Abe’s for 28 years, followed with a few personal touches of a lighter nature.

## New Quaternary Sediment Lab

The Department welcomed a new laboratory this November. The Quaternary Sediment Lab in Hogan Hall will provide space and equipment for Professor Yarrow Axford and her students to analyze sedimentary records of Quaternary environmental change. Axford specializes in high-resolution reconstructions of Holocene environmental and climate change in arctic and alpine regions, and much of her research involves collection and analysis of lake sediment cores. The new lab is equipped with a cold room for long-term refrigerated core storage; equipment for sediment core splitting and logging; and instrumentation for physical, geochemical, and paleoecological analyses of sediments, including magnetic susceptibility measurements, spectrophotometry, and elemental analysis. The lab also includes a microscopy facility devoted to paleoecological analyses. The lab’s stash of field gear includes a wide range of sediment sampling devices and instruments for monitoring climate and water quality, including Hobo loggers intended to overwinter in remote arctic lakes and provide hard-to-obtain data describing seasonal changes in temperature and lake ice cover.



changes with wave action on Lake Michigan, wind speed, rainfall, barometric pressure, etc. Visiting groups of diverse middle- and high-school students observe that the amplitude of their recorded jumps decreases as they move away from the seismometer, and they found that not even collectively could they make our basement floor move as much as did the August 23, 2011, earthquake in Virginia.

**Technology:** The actions, and experiments of students (from 3<sup>rd</sup>-grade to graduate) are recorded in real time on a computer screen. Students can zoom, scroll back in time, pick P and S waves of a real earthquake and estimate its distance, filter traces, extract sections, save files for classroom analysis, etc. Even experienced seismologists are as fascinated by such real-time data as by the archived data.

**Engineering:** A seismometer converts physical ground motion into differential motion relative to a viscoelastically suspended mass, then converting this barely perceptible mechanical motion to a measurable analog electrical signal which is digitized for computer-based processing. Each of these transcription/conversion steps manifests remarkable engineering and provides unique teaching opportunities for Newton’s laws, the wave equation, interplay of viscous and elastic components, ideal vs. real systems, linear and non-linear responses, electromag-

*Continued on page 7*

## Our Solo Seismometer

Between the professional seismometer that Professor Okal has maintained for decades and the improvised seismometers built by students in *EARTH 360 Instrumentation and Field Methods* the Department now owns a solo, straight-lined, deep-green, nuts-and-bolts, vertical-component demonstration seismometer, thanks to the efforts of Professor van der Lee and the generosity of the Cohen Family Fund.

For the past two years this seismometer has served multiple purposes. First tested on a field trip to the Yucatán (2010), it

demonstrated that hands-on monitoring of global energy release (large earthquakes) is as valuable for student learning as hands-on monitoring of local energy flux. Upon subsequent installation in Locy Hall, it has served to demonstrate the important roles of observation, technology, engineering, and mathematics in Earth Science. We also use it to record alumni “footprints”; please jump near our seismometer on your next visit.

**Observation:** Seismometer data looks subtly or dramatically different each day. One senior research project correlated these

## EPS Welcomes and Goodbyes

**Welcome** to new staff members: Research Associate/Stable Isotope Lab Manager **Dr. Koushik Dutta**, Research Associate/Radiogenic Isotope Lab Manager **Dr. Alain Potrel**, Financial Assistant **Ben Rice**, and Quaternary Sediment Lab Research Technologist **Grace Schellinger**. New Graduate students: **Grace Andrews**, **Matthew Jones**, **John Lazarz**, **Shuoxian**

**Ning**, **Sara Rastegar**, and **Forrest Webb**. New Postdoctoral Research Fellows: **Dr. Xiaobing Liu** and **Dr. Min Sub Sim**. With great joy we welcomed Professor Matthew Hurtgen's baby, **Allegra**... **Goodbye** to staff members: Technical Support Consultant **Tim Johnson**, and Business Administrator **Reid Wellensiek**, (now Research Administrator in the Weinberg

College of Arts and Sciences) and Radiogenic Lab Manager **Dr. Zhaofeng Zhang**; Faculty: retired but **Emeritus Professor Abraham Lerman** (see page 3), **Professor Francesca McInerney** and her family, Visiting Researcher **Dr. David McInerney**, and their baby, **Owen**. Farewell also to the 2012 graduates (see below).

## 2012 Graduations

Two of our final celebrations held in Locy Hall last summer were a Graduation Reception for our eight undergraduates and their families, and a sendoff for Ph.D. graduate **Dr. Carl Ebeling**. Carl landed a job as Chief Seismic Engineer for the IRIS-IDA network, based at the University of California, San Diego. Graduate student **Karen Tekverk** graduated with an MA, and is now pursuing her interest in geoscience education. We wish all of you well in your new endeavors.

## 2012 Undergraduates

**Clayton Brengman**  
**Peter Carlson\***  
**Catherine Carrio**  
**Alice Carter\*..\*\***  
**Ekjyot (Joey) Gill\***  
**Benjamin Heath**  
**Daniel Pfeffer**  
**Matthew Strumpf**

\* Graduated with honors

\*\* Received the *Seymour Schlanger Undergraduate Earth Scientist Award*



## Donna Jurdy – Female Faculty Leader and Mentor



The year 2012 has included a number of recognitions of Professor Donna Jurdy's excellence in undergraduate mentorship, leadership amongst female faculty, and the international reach of her educational efforts in Planetary Sciences.

Donna serves on the Board of Directors of the Association for Women Geoscientists (AWG) and this year received AWG's *Encourage Award*, "For her tireless sponsorship of student memberships and for her support of women at every stage of their careers including your advocacy for the *Professional Excellence Awards*."

Thanks to her enthusiastic freshman advisees, Donna received the 2011-2012 Weinberg College *Outstanding Freshman Advising Award*. The students in Donna's long-standing Freshman Seminar, *The Death of the Dinosaurs* see her as always approachable, sensitive to their needs, and being widely knowledgeable about the College and University. Her ability to guide freshman in their personal and professional growth and to instill confidence and independence is demonstrated by the strong ties developed: many advisees remain in contact with Jurdy long past graduation.

Recently, Donna has also taken up the invitation to teach *Exploration of the Solar System* at the Graduate University of the Chinese Academy of Sciences (GUCAS) in Beijing, hosted by faculty member Han Li (EPS Ph.D. 2006). Her course exceeded the combined

enrollment for all other Visiting Professors. With a wealth of experience, and teaching materials developed while teaching *Exploration of the Solar System*, and more recently, *Forming a Habitable Planet*, an intense series of five lectures, each four hours long, were delivered over ten days. Donna reports that the grueling pace and large class size, combined with the inevitable technological hurdles in presenting material, were well rewarded by warm camaraderie with Han Li, interactions with appreciative students, enjoying great cuisine, and exploration of some of China's most wonderful natural landscapes and cultural sites. When the Chinese may walk on the moon - perhaps before U.S. astronauts return - Donna will wonder whether her course sparked an interest in a young graduate student!

### *New Home, continued from page 1*

places EPS squarely in the center of sciences on campus, near our new research lab facility, ILEPS, in close proximity to joint faculty members in Civil and Environmental Engineering, and the Seeley G. Mudd Science Library. In fact, we need not leave the building to reach those places, since a labyrinth of hallways and bridges connects us to them. Already, we feel more connected and are looking forward to the interdepartmental alliances the move facilitates. On the moves, Professor Bina reflects: "I recall Larry Sloss reminiscing about how they used to do their geochemistry experiments in mayonnaise jars in the basement of University Hall. Someday soon we'll be reminiscing about how we used to haul cylinders of compressed gas up the stairs of Locy Hall."

## Faculty Highlights



**Yarrow Axford's** research this year focused on the Quaternary climate history of Greenland, southwest Alaska, and the Peruvian Andes. Yarrow, a paleolimnologist who specializes in arctic and alpine regions, is collaborating with three different teams of glacial geologists in these study areas to examine how climate (reconstructed using lake sediment records) has interacted with glaciers, ice sheets, and ecosystems in Earth's recent past. Lab work this year has focused on sediment cores Yarrow collected with colleagues in the Aleutian Islands in 2010 and East Greenland in 2011. The success of both field seasons means that there is plenty of exciting laboratory research for EPS students with which to get involved! The department's new Quaternary Sediment Lab opened in November and includes cold storage for sediment cores, microscopy facilities for micropaleontology, and analytical capabilities for characterizing physical and chemical properties of sediments (see page 3).

While planning and executing the move of EPS to the Technological Institute, research efforts advance for **Patricia Beddows** with Ph.D. student Emiliano Monroy-Ríos and several undergrads. Emiliano is assessing the potential release of geologically sequestered phosphorus and iron from the carbonate Yucatán Platform, with implications for coastal ocean chemistry at low latitudes in a warming world with rising sea levels. Emiliano has completed the bulk rock analyses of 200+ samples, most collected while cave diving with Patricia, coupled with a sed-strat framework above and below water for the region, which culminated in an oral presenta-

tion at the 2012 GSA. Undergraduate research projects with Peter Ilhardt focus on carbonate rock characterization and analysis from the Yucatán Peninsula, and Ellie Bensinger is working to provide a proxy of past fire events using charcoal in lake sediment cores from the Belize Maya jungle. Patricia is pleased to report that 2011-2012 undergraduate mentees



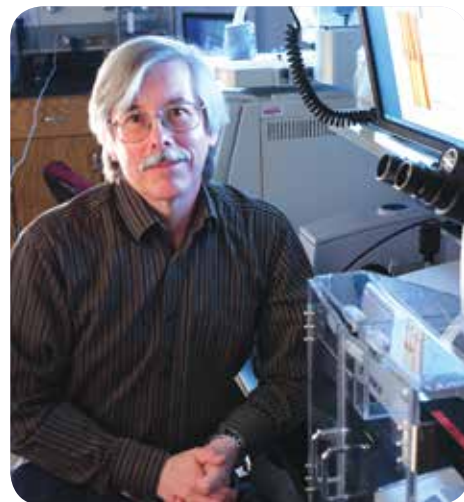
are flourishing, with Peter Carlson pursuing his Ph.D. at the University of Texas, Austin, and Alice Carter taking up an instructional contract at the MBL unit of Wood's Hole.

**Craig Bina** spent the first half of 2012 on research leave, following completion of his years of service as Associate Dean of WCAS. During the winter he was a visiting scientist at the Lunar Reconnaissance Orbiter Camera (LROC) Science Operations Center at the School of Earth and Space Exploration at Arizona State University, where he worked with (former NU faculty member) Mark Robinson on the modeling of lunar stress fields. In the spring he returned as a visiting researcher to the Department of Geophysics at Charles University in Prague (Czech Republic), where he worked with colleagues on problems of subduction dynamics. He completed articles on mantle composition with (former NU grad student) George Helffrich, on Taiwanese subduction with (former NU grad student) Po-Fei Chen, and on mantle thermal conductivity with (former NU postdoc) Sylvia-Monique Thomas and Steve Jacobsen, while also launching new collaborations with colleagues at Argonne National Lab. This fall he began a year of service as Interim Department Chair, while Brad Sageman is on leave.



*Craig Bina atop a limonite-encrusted tectonic block of Cretaceous Elbe sandstone near the Labe river in northern Bohemia.*

**Neal Blair's** Biogeochemistry Laboratory is investigating carbon cycling on subducting margins. Ph.D. student Laurel Childress will be studying the behavior of sedimentary organic carbon on the New Zealand, Cascadia and Alaskan margins as part of a new NSF-sponsored project. Laurel will also be participating in an IODP expedition to the Alaskan margin. As part of the research, high tempera-



ture and pressure simulations of organic carbon subduction will be performed in collaboration with Steve Jacobsen. A new ACS-PRF project focuses on the role of soil fungi in the sequestration of lipid biomarkers. This project is in collaboration with Dr. Louise Egerton-Warburton of the Chicago Botanical Garden.

**Matt Hurtgen's** research is centered

on reconstructing the chemical evolution of Earth's oceans and atmosphere over the past 1 billion years. The goal of this research is to better understand



the couplings and feedbacks that are responsible for regulating the biogeochemical cycles of carbon, sulfur, and oxygen (and therefore climate), now and in the geologic past. His research team includes graduate students Maya Gomes, Jeremy Gouldey and Brian Kristall and undergraduates Caroline Binkley, Laura Beckerman, Alex Kegley and Jennifer Mills, who are all exploring the possible role the sulfur cycle plays in regulating the global carbon and oxygen cycles in the Cretaceous. Jeremy and Caroline are reconstructing the sulfur isotope composition of carbonates associated with Neoproterozoic snowball Earth events in order to better understand the link between ocean chemistry, oxygenation of Earth's atmosphere and global glaciation. Additionally, Matt is thrilled to welcome a new postdoc, Dr. Min Sub Sim (see story on page 2).

**Steve Jacobsen's** Mineral Physics Laboratory studies the materials science of geochemical and geophysical processes, from crust to core. In 2012, the group was joined by Postdoctoral Researcher Dr. Xiaobing Liu from the State Key Laboratory of Superhard Materials in Jilin, China. Xiaobing is studying the incorporation of boron into diamond, an exciting new semiconductor. In May 2012, Jacobsen gave a talk at Cornell on the role of high-pressure minerals in Earth's deep water cycle. Jacobsen continues to work with a team from Carnegie Institution to develop a new high-pressure infrared beamline at the National Synchrotron Light Source II, which was selected in 2012 as one of the



*Jacobsen serves on the Infrastructure Development Committee of NSF-COMPRES and he began work as an Associate Editor of *Geophysical Research Letters*.*

NxtGen Project beamlines to be built by the DOE.

**Andrew Jacobson** became Director of the Environmental Sciences Program in the fall of 2011 and remains Director of Undergraduate Studies for EPS. During the winter of 2012, Jacobson was a visiting Erskine Fellow at the University of Canterbury in Christchurch, New Zealand. Jacobson and his former Postdoctoral Researcher, Dr. Jong-Sik Ryu, published a paper in *Chemical Geology* showing how evasion of CO<sub>2</sub> from rivers draining the Greenland Ice Sheet could act as a positive feedback to global warming. Ph.D. student Greg Lehn continues to investigate climate change



in northern Alaska and is pioneering methods for measuring Ca isotopes by thermal ionization mass spectrometry. New members to Jacobson's group include Ph.D. student Grace Andrews, who is studying chemical weathering in the Fiordland area of New Zealand, Ph.D. student Forrest Webb, who will quan-

tify fractionation of Ca and Sr isotopes during synthetic carbonate mineral precipitation, and Dr. Alain Potrel, who is managing Jacobson's Radiogenic Isotope Facility.

**Donna Jurdy** works on planetary surfaces to understand their tectonics and evolution. She continues work on Venus with alum Paul Stoddard (now faculty at NIU) analyzing the topography of features, such as coronae and chasmata, and comparing them with well-known terrestrial features that may be analogues. Working with graduate student Ashley Gilliam, she is analyzing craters on Titan. They seek to peer below Titan's surface for clues about the subsurface ocean. She also works with graduate student Renee French on the magnetization of the Meridiani region of Mars. The welcome recognition of excel-



lence in mentoring, and the reach of her Donna's teaching in Planetary Sciences are detailed on page 4.

**Abraham Lerman** retired on August 31, 2012, but taught *Earth's Changing Climate* Fall 2012 quarter nonetheless. See the *Welcome and Goodbyes* story on page 2 for more on Abe.

The work of **Cesca McInerney** and her lab group on the Paleocene-Eocene Thermal Maximum (PETM) was highlighted for Earth Day on the NSF Science 360 web page because of the parallels between the PETM and possible future warming. McInerney's research on developing hydrogen isotope ratios of leaf waxes as a paleoaridity index has

landed her an Australian Research Council Future Fellowship at the University of Adelaide in Australia. She began this work September 2012, but will remain involved with on-going student research at Northwestern as an Adjunct faculty member.

**Emile Okal** participated in the surveying and sampling of limestone megablocks on the platter of the atoll of Anaa, such as this one, reaching 400 m<sup>3</sup> and

*Anaa,  
French Polynesia,  
13 March*



more than 600 tons. Rock and shell samples are presently being dated in France, the ultimate goal being to determine if they were deposited by

tsunamis or major cyclones. In the meantime, the local fauna provided an exquisite lunch...

**Brad Sageman's** administrative work since the last newsletter focused on completion of the Tech Infill project (our new offices), where we moved in September, and faculty recruitment to fill positions vacated by Lerman and McInerney. Brad's major research activities



included work with University of Wisconsin-Madison colleagues on Cretaceous chronostratigraphy, as well as collaborations with several other research groups

on a variety of projects. He is co-author of two 2012 publications, and three others that are currently in revision. Brad has continued work on sustainability and environmental issues on campus in 2012 through his role as Associate Director of Education and Special Projects for the Initiative for Sustainability and Energy at Northwestern (ISEN) and as one of the organizers and instructors for the Environmental Field School. He spent the first part of the summer doing field work in Utah and Colorado, and returned in early July to finish a new grant proposal incorporating chemostratigraphy and biostratigraphy into his ongoing Cretaceous time scale project.

**Seth Stein** has been working with his father Jerome Stein, Professor Emeritus of Economics at Brown University, to explore how societies can develop strategies to mitigate natural hazards that make economic and societal sense, given that our ability to assess these hazards is poor. In the words of our friend, Japanese economist H. Hori, "What should we do in face of uncertainty? Some say we should spend our resources on present problems instead of wasting them on things whose results are uncertain. Others say we should prepare for future unknown disasters precisely because they are uncertain". They have developed a framework to find the optimal level of mitigation by balancing its cost against the expected damages, recognizing the uncertainties in the hazard estimates.



**Suzan van der Lee** and students are analyzing data from Earthscope's USArray and its SPREE component around the mid-continent rift system, which is co-led by Northwestern. She co-convened a session at the 2012 fall AGU meeting on Initiation and Evolution of Rift Systems. She attended the Monitoring Research Review to advance her modeling work on the seismic structure of south and east Asia, which contains contributions from students and former postdoc Dr.

Sung Joo Chang. Suzan is completing her terms as Secretary of AGU's Seismology section and as member of the IRIS EPO standing committee. She managed



the seismology kiosk in Locy Hall, which supports STEM education and outreach from Grade 3 through graduate level. She co-taught *Instrumentation and Field Methods* in which she and her students developed a handful of amateur seismometers. She also taught *Seismology and Earth Structure* and once again demonstrated shallow seismic imaging with a 24-geophone string borrowed from IRIS.

#### *Solo Seismometer, continued from page 3*

netics, electrical circuits, RC filters, signal amplifiers, bits and bytes, and digitization, etc.

**Mathematics:** The wave equation is a partial differential equation. Additional mathematics are involved in instrument design, instrument response representation in complex functions, digital signal processing theory relying heavily on Fourier transforms, etc.

We love our solo seismometer. It helps us teach our students and those among the communities in which we live. As you read this, it will have moved to the basement of Seabury Hall, previously part of a theological seminary. There it will live among many drawers of microfiche and microfilm of historic earthquakes, further highlighting the role of technology in our ability to study the Earth. We look forward to showing you around and digitally archiving your "footprint" during your next visit.

## Upcoming Earth Scientists!

**O**ur growing number of 26+ undergraduates venture to all corners of the world, dedicate themselves to intensive work and play, and undertake cutting-edge research, often with the financial support of the prestigious Undergraduate Research Grants (URG).

**Laura Beckerman** received a URG from ISEN to study a Cretaceous Ocean Anoxic Event, and she was the only undergraduate to attend the International Summer School in Astrobiology in Santander, Spain...

**Caroline Binkley** is analyzing rock samples from Svalbard to develop a sulfur isotope record for the Sturtian Glaciation, the first Snowball Earth of the Neoproterozoic... **Danny Ginzburg** received a URG to grow and characterize novel silica-based aerogel, with the goal of using the isotropic gel properties to stabilize certain phases of superfluid helium-3...



**Harry Hahn** worked at Earthbound Farms, the largest U.S. organic produce farm, over the summer, and will move to Austin, TX after graduation to work as a Cloud Ninja Consultant for the San Francisco Consulting Group... **John Hodges** worked last summer for an energy company to develop novel approaches for metering electric and gas consumption by leveraging datasources and analytical software... **Peter Ilhardt** took summer chemistry courses and is now examining water-rock chemical interactions in carbonate aquifer systems... **Leah Isaman** worked at the Smithsonian Natural History Museum in the botany department over the summer and was inspired by the 5+ million samples and 17th-century botanical journals, including those of Captain James Cook... **Katie Jaycox** dedicated her

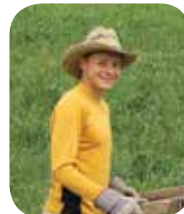
summer to *Breakthrough Austin*, teaching science to 7<sup>th</sup> grade students. She reports it to be some of the hardest, yet most rewarding work she has ever done... **Alex Kegley** received a URG from ISEN, to research Cretaceous ocean chemistry... **Zach Kisfalusi** was a summer intern with Multicultural Student Affairs and served as a summer counselor for the *Summer Academic Workshop*, a pre-orientation summer program. Zach continues to be the co-director of WNUR Sports, the student radio station...



**Margaret Koepfel** gained first-hand experience in atmospheric science setting up hot air balloons. She also finds time to run a jazz band and be a member of the



boxing team... **Andrew Kozminsky** is designing an experiment to test osteoblast stimulation in zero gravity, which he hopes will be selected to fly in the NASA "Vomit Comet"... **Brian Lach** spent last summer researching worm-soil-agriculture interactions at the University of Utah, and he is now also a minor in the Environmental Policy and Culture Program... **Alex Layng** spent his sixth summer as a geology intern at the Field Museum archiving the fossil invertebrates. He will co-present on his work at the upcoming SPNCH Conference... **Oscar Lopez** attended an NSF-Research Experiences for Undergraduates at the



Smithsonian Museum of Natural History where he studied the geochemistry of the mantle, leading to a presentation at the Fall AGU meeting... **Allie Mayer** was a NOAA summer intern in Hawaii studying declining snow cover on Mauna Kea, and continues to research C and S cycles during Ocean Anoxic Event II in the Western Interior Seaway... **Ariel Melinger-Cohen** dedicated his summer to advocating for sustainable practices while traversing the mainland United States, much of the time on foot!... **Jenny Mills** was a NOAA Hollings Summer Scholar researching magnetosphere-ionosphere interactions and will present her research on Ocean Anoxic Event II at the Fall AGU. She recently won a prestigious Marshall Scholarship



to attend Cambridge University and the University of Edinburgh... **Ruth Norval** attended the *Australian Environment, Wildlife, and Conservation Program*, where she studied wildlife and conservation practices in Australia at sites from Kakadu to the Blue Mountains... **Nora Richter** has been studying geology, ecology, and culture across New Zealand, with experiences in the Pacific Ocean, temperate rainforests, glaciers, mountains, hot springs, and caves... **Matt Sullivan** received a WCAS Summer Research Grant to study the intersection of science and commerce in the Moroccan fossil trade. Starting in Rabat and then heading into the southern deserts, he found little communication between the scientist and the handful of educated dealers.



## Graduate Student Awards



The Department graduate program continues to break records for success both in prestigious external fellowship competitions and small grants. See table below to find out who won what in 2012.

Nature of Award		Name	Grant or Award
External Funding	Multi-year Fellowship	Rosemary Bush	EPA STAR Fellowship - Year 3 of 3.
		Greg Lehn	EPA STAR Fellowship - Year 3 (deferred) of 3.
		Maya Gomes	NASA Earth and Space Science Fellowship - Year 3 of 3.
		Emiliano Monroy-Ríos	Consejo Nacional de Ciencia y Tecnologia (CONACYT) Research Fellowship - Year 2 of 4.
	Academic Year Fellowship	Laurel Childress	Schlanger Ocean Drilling Fellowship
		Jessica Lodewyk	Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA) Reach for the Stars JK-12 Educational Outreach Fellowship
	Summer Fellowship	Joshua Townsend	NSF Japan Society for the Promotion of Science (JSPS) Summer Program Fellowship
		Michael Witek	East Asia and Pacific Summer Institutes Fellowship
	Small Research Grants	Rosemary Bush	Paleontological Society Student Research Grant
			Sigma-Xi Research Grant
Travel		Association of Women Geoscientist (AWG) Virginia Sand Travel Award to GSA	
Internships	Trevor Bollman	Chevron Corporation	
	Miguel Merino	Chevron Corporation	
	Renee French	Lunar and Planetary Institute (LPI) - Lunar Exploration Summer Internship	
EPS Awards	Renee French	Outstanding Teaching Assistant	
	Xiaoting Lou	Outstanding Graduate Research	

## Graduate Updates

**Kimberly Adams** published an article in *Geophysical Research Letters* on optical reflectivity of methane at 50-100 K with application to understanding hydrocarbon lakes on Titan and published a paper in *Planetary Space Science* on analyzing pit distributions in the equatorial region of Titan.



**Grace Andrews** is investigating the chemical weathering rates in Fiordland, New Zealand, as well as the governing controls on weathering

and the implications for CO<sub>2</sub> consumption, through the geochemical analysis of its river waters with an emphasis on isotope studies.

**Allison Baczynski** spent January at the University of Bremen Core Repository in Germany, where she split, described,

scanned, sampled, and archived over 920 meters of continental core that her team had drilled from Bighorn Basin, WY, in July, 2011. She continues to analyze the samples they collected in an effort to better understand the effect global warming events had on the carbon and hydrologic cycles.

**Trevor Bollman** is working toward creating a tomographic model of the Mid-Continent Rift using teleseismic P and S waves, and took an uneventful trip to Ontario to service SPREE seismic stations in late May. Over the summer, Trevor was a Professional Intern at Chevron in Houston on the Gravity, Electric, & Magnetic Services Team.

**Rosemary Bush** was awarded two research grants to support her work on the effect of temperature on plant alkane biomarkers along a transect across the central US. In September, she drove from International Falls, MN, to Brownsville, TX, to collect samples for her research.

She also attended a course titled Tropical Botany, taught by botanist Walter Judd, at the Kampong in Miami, FL, and has been working in the lab to analyze the leaf fossils she collected from Ethiopia.



**Yun-Yuan Chang** attended a DOE review of the Carnegie/DOE Alliance Center for High Pressure Science and Technology, held at the Advanced Photon Source of Argonne National Laboratory. In 2012 she co-authored two papers. She began collaborating with Professor Tetsuo Irifune, Director of the Geodynamic Research Centre in Ehime, Japan, on studying elastic properties of nanopolycrystalline diamonds. In July, she attended the annual NSF-COMPRES meeting in Tahoe, CA.

A recipient of the Schlanger Ocean Drilling Fellowship, **Laurel Childress** participated in a 30-day seismic imaging cruise of the Juan de Fuca plate, aboard the R/V Langseth. She continues to study the recycled carbon of previous Ocean Drilling Program cores collected in Cascadia. Earlier in the year she developed and taught a *Geographic Information Systems* (GIS) course specifically for Earth and Environmental Science majors.

**Carl Ebeling** had two papers accepted for publication in 2012 and successfully defended his Ph.D. dissertation in September. Carl relocated to San Diego, where he now works as Chief Seismic Engineer for the IRIS-IDA network, based at the University of California.

**Renee French** has been investigating small-scale graben, which were detected with the Lunar Reconnaissance Orbiter Camera (LROC). She spent the summer at the Lunar and Planetary Institute (LPI)



to assess all lunar landing sites that will address the composition and structure of the interior. While at LPI, she presented an abstract (co-written with fellow graduate student Josh Townsend) at the 2012 *Concepts and Approaches for Mars Exploration* workshop on why we need to put seismometers on Mars.

**Ashley Gilliam** is interested in planetary habitability and Saturn's moon Titan. She is examining the impact craters on Titan and their relation to a possible subsurface ocean with Professor Donna Jurdy. Ashley hopes to expand Titan's catalog of craters and use them to confirm the existence of a large liquid layer under Titan's ice shell. Ashley is also working on a project with Professor Abraham Lerman, examining the chemical and physical properties of Titan's atmosphere, its evolution, and its comparison to Earth's primordial atmosphere.

**Maya Gomes** has been compiling sulfur and carbon isotope records from Cretaceous oceanic anoxic event sections to evaluate what role the sulfur cycle plays in the initiation and/or termination of widespread anoxia in the ocean. Additionally, she submitted a paper co-authored with her advisor, Professor Matthew Hurtgen, to the journal *Geology*. In June, she presented her work at the 22<sup>nd</sup> V.M Goldschmidt Conference in Montréal.



**Jeremy Gouldley** has been reconstructing the isotopic evolution of sulfur and carbon during the Cryogenian Interglacial Interval (between two Snowball Earth events) to explore biogeochemical relationships in the ancient ocean, to study the importance of changing sulfate concentrations, and to better understand the mechanisms behind extreme climate perturbations. He has submitted a second paper for publication.

**Young Ji Joo** focused on building a combined chemostratigraphic – biostratigraphic correlation scheme for the Late Cretaceous North America (Western Interior) and Europe. She also built a hypothesis to examine the relationship between carbon and sulfur cycling during the Mid-Late Cretaceous. The carbon and sulfur isotope study is expected to demonstrate how these two elemental cycles, and ultimately the ocean-climate system responded to changes in volcanic and tectonic activities.

First-year student **Matthew Jones** is developing projects to increase the accuracy and precision of timing, chemical



signals, biostratigraphy, and field interpretation of geologic events in the Cretaceous as preserved in the Western Interior and elsewhere.

**Brian Kristall** is investigating the influence the global sulfur cycle had on the evolution of ocean chemistry and surface conditions during the Early Cretaceous and the possibility of using barite and sedimentary barium concentrations as a proxy for changes in marine sulfate concentrations during the low sulfate oceans of the Mid-Cretaceous. Brian published a second paper from his prior masters research in *Chemical Geology*.

First-year student **John Lazarz** studies high pressure and high temperature crystallography. He creates conditions similar to those of the deep Earth, using diamond-anvil cells, under which unique reactions occur and novel structures exist. He is interested in applying atomic-



scale structure and physical properties of materials to large scale processes that take place within both the Earth and technological materials under extreme conditions.

**Greg Lehn**, supported by his EPA STAR Graduate Fellowship, is investigating calcium isotopes and stream geochemistry as a proxy for permafrost thaw depth and carbon export on the North Slope of Alaska. In February, he participated in fieldwork collecting water samples in the Fiordlands, New Zealand. Greg spent his summer analyzing Ca and Sr isotopes in soil and river water samples. In June, Greg presented his research at the 2012 Goldschmidt Conference.

**Dan (Darcy) Li** is engaged in several projects associated with biogeochemical cycle of C-N-P-Si using a modeling approach under the supervision of Professor Abraham Lerman and Professor Fred MacKenzie from University of Hawaii. Currently, she is trying to resolve the causality of global Si biogeochemical cycles and marine Si paleoproductivity changes since the Last Glacial Maximum.

**Jessica Lodewyk** continues her work with Professor van der Lee on computational modeling of seismic waves. She is also working with Professor Okal to determine the focal mechanisms of historical earthquakes, relocate those earthquakes, and determine the moment

tensor solution. This summer she worked with the Reach for the Stars Fellowship Program teaching 4th-6th grade students computer programming. During the 2012-13 academic year, she will work with a local school integrating computer science into the science curriculum as well as continue her research.

Last year, **Xiaoting Lou** developed a Python/Matplotlib tool to measure teleseismic body wave arrival times from IRIS PASSCAL and EarthScope USArray data. He submitted a paper about the tool to *Seismological Research Letters* and has released the tool for public use, available from his website. Two of his manuscripts are near final: one co-written with Professor van der Lee, and a second with Professor Jacobsen. He has started working on a third paper about joint tomographic inversion for North American mantle velocity structures.

In January 2012 **Miguel Merino** presented his work on intraplate earthquakes at an international conference in Gujarat, India. This summer Miguel worked for Chevron, reprocessing a 3D seismic survey, which led to new interpretations of the subsurface. Miguel presented his gravity model results at AGU this year. His research plans for 2012/13 include gravity modeling of the Mid-Continent Rift and continued work on a major strike-slip earthquake pair located off the coast of Sumatra in early 2012.

**Emiliano Monroy-Ríos** continues on his four-year research fellowship from CONACYT – the NSF of Mexico – focused on the desorption and preferential dissolution of the key elements P and Fe from the fresh-saline stratified coastal carbonate aquifer of the Yucatan Peninsula. The potential eutrophication from increased discharge of these geologically sequestered elements under rising sea level is of concern. Initial results were presented orally at the 2012 GSA Annual meeting.

First-year student **Shuoxian Ning's** research interests focus on seismic imaging, tectonophysics and geodynamics. The goal of her research is to refine the Earth's seismic velocity model by analyzing seismic data as well as



other data, such as gravity.

**Sara Rastegar** is studying the thermal phase variations of an eccentric hot-Jupiter, XO-3b, using Spitzer Space Telescope data. She uses simple models to study heat absorption and transportation in



the atmosphere, and utilizes statistical tools to define the best-fit-model. She is also part of a Spitzer Space Telescope proposal in which they compare thermal phase variations of XO-3b and HAT-P-2b, two similar planets with mirrored viewing geometry, which allows them to study atmospheric circulations from opposite hemispheres.

**Amir Salaree** is interested in the characteristics and mechanisms of deep



and intermediate-depth earthquakes. This research involves the evaluation of anisotropies in the Earth's mantle and how these affect the radiation paths of earthquake waves. Amir uses many different approaches, including structural and seismological analytical methods, and thermodynamics.

**Karen Tekverk** graduated with a Master's Degree in August of 2012. Over the last year, she developed a relationship with the NU Learning Sciences Department in the School of Education and Social Policy, working with advisors in both EPS and Learning Sciences. Karen's research focuses on geoscience education.

During his summer at the Geodynamics Research Center at Ehime University in Matsuyama, Japan, as a NSF/JSPS Summer Program Fellow, **Joshua Townsend** worked on modeling hydrogen defects in high-pressure crystal structures hypothesized to exist both at the base of the Earth's mantle as well as in large rocky exoplanets. This work complements his work at NU, which has been focused on



developing experimental techniques to synthesize and characterize high-pressure hydrous materials.

First-year student **Forrest Webb's** research focuses on calcium and strontium stable isotope fractionation during synthetic calcite precipitation experiments.



During an East Asia and Pacific Summer Institutes Fellowship, **Michael Witek** worked with Dr. Tae-Seob Kang on ambient seismic noise analysis in the Korean peninsula. Dr. Kang has constructed a three-dimensional surface wave tomographic image of the upper crust using seismic noise correlations. In order to better constrain their tomographic models, Michael's summer work helped to quantify uncertainties in surface wave dispersion measurements.

In January of 2012, **Emily Wolin** attended the Indo-US Workshop on Intraplate Seismicity in Gujarat, India as an invited speaker. Her work with Professor Seth Stein on earthquakes along the east coast of North America was published soon after. Emily is now working with Professor Suzan van der Lee to develop a new tomographic technique. She and fellow graduate student Michael Witek completed another successful service run to SPREE stations in April. At the 2012 IRIS Workshop in Boise, ID, Emily presented an evaluation of noise characteristics and data quality for SPREE stations during the first year of deployment.

**LinkedIn**

The Department has recently created a LinkedIn Group called Northwestern University Department of Earth and Planetary Sciences. We hope you'll connect with us!

## Alumni News

**Carl Bowin** (MS 1957) Emeritus Scientist, Woods Hole Oceanographic Institute, published "Plate Tectonics Conserves Angular Momentum" in [www.electronic-earth.net/](http://www.electronic-earth.net/) 5/1/2010, and writes that he is "Still alive and well." ... **Howard Ross Cramer** (Ph.D. 1954) has retired, but writes that he is "Still vertical"... **Dan Jidanni Jacobson** (BA 1987) "You can publish that I am actively accepting couchsurfers, <http://www.couchsurfing.org/people/jidanni/> at my mountain home. However as I have discovered the action is on the surface of the earth rather than inside, I more just tinker with maps nowadays. <http://jidanni.org/geo/>"...

**Kathleen Johnson** (Ph.D. 1990) "I am working with the Digital Globe Research Lab on the Data Mining/Data Integration Team focusing on the GIS/Geology/Land-cover applications. We work on basic research in remote sensing integration of our satellite data with government and other sources (e.g. LiDAR, ASTER, AVRRIS, Open Street Map) and expanding applications for our WorldView-2 Satellite 8-band data. I also collaborate with the New Product and Product Improvement Teams. We live in Longmont, Colorado -12 miles NE of Boulder. I have a wonderful <20 minute commute to work driving through farmland"...

**Eryn Klosko** (Ph.D. 1997) "I have been at SUNY/Westchester Community College now for 10 years. For the past 4 years I

have been the Physical Sciences Department Chair. Last year, I was a recipient of the State University of New York Chancellor's Award for Excellence in Teaching. My husband Adam and I live in Riverdale with our 4-year-old daughter, Madeleine"... **Sarah Krentz** (BA 2006) "I received my MS in Earth and Environmental Sciences from Vanderbilt University in 2009 and have been a Lecturer at Middle Tennessee State University since then"... **Han Li** (Ph.D. 2005) works as a Researcher at the Graduate University of the Chinese Academy of Sciences, in the



College of Earth Sciences. Han Li invited Professor Donna Jurdy, to be a Visiting Professor over the summer of 2011...

**Fritz G. Nagel** (MS 1951) "Although I

flew to Alaska's North Slope many times while employed in petroleum exploration, I drove there for the first time last July when a friend, who owns a motor home, invited me to join him on a round trip to Deadhorse. I enjoyed viewing sedimentary rock outcrops in the Brooks Range and northern foothills of formations I had studied in the subsurface at Prudhoe Bay and other fields on the coastal plain"... **Andy Newman** (Ph.D. 2000) reports that "In case you haven't already heard, life just changed dramatically for us in the last 12 or so hours

[9/27/12]. Ivy, Porter and I are all doing great! So much so that we've created a blog already with a few photos. <http://porternewman.blogspot.com/> I'll update as time, Ivy, and caffeine allow"... Last fall **Philip Richardson** (Ph.D. 1998) interviewed current EPS students who have an interest in working for Chevron. Then he departed for Scotland to work on North Sea exploration as Geophysical Coordinator, Chevron Upstream Europe, where he will work in the UK, Norway, and possibly in Eastern Europe... **Michael Robotham** (BA 1988) After many years in Hawaii, Michael became National Leader -- Soil Interpretations for USDA-NRCS, National Soil Survey Center in Lincoln, NE... Undergraduate **Julia Swanson** (BA 2011) co-authored a paper on minerals in cement chemistry appearing in the July 2012 issue of *American Mineralogist*... **Joseph Walkowicz** (BA 2011) "I am just beginning my second year of graduate school at the University of Chicago. I spent ten weeks of the summer at Friday Harbor Laboratories, a marine research facility on San Juan Island. While at Friday Harbor, I proposed and completed two projects on invertebrate zoology and biomechanics. This autumn I've begun writing my prospectus on macroevolutionary trends of disparity in the fossil record"... **Joe Werne** (Ph.D. 2000) "Moving to a new job at the University of Pittsburgh this year."

## Climate Change Symposium

This spring, the Department once again took a leading role in organizing a major public event addressing the science of climate change. More than 300 people from NU and surrounding communities attended the 2012 Northwestern Climate Change Symposium in March. The day-long event, co-sponsored by EPS, ISEN and the Program in Environmental Policy and Culture, brought an international group of prominent speakers to campus to discuss the impacts of climate change. Yarrow Axford moderated, and Matt Hurtgen gave a lecture titled, "Deep time perspectives on climate change: Why ocean chemistry matters." Dr. Richard Alley, Professor of Geosciences at Penn State University and a fellow of the National Academy of Sciences and the American Geophysical Union, delivered the keynote address to a packed auditorium.

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