

# epicenters

The Newsletter of the Department of Earth and Planetary Sciences at Northwestern University | 2011

JUDD A. AND MARJORIE WEINBERG COLLEGE OF ARTS AND SCIENCES



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## Message From the Chair

**G**reetings to Alumni and Friends, There is lots of good news to share – although some of it is also sad, as you will see. I will touch on a few points, but you will find all the details in the articles contained herein. We hope you enjoy the new newsletter format – let us know if there are ways we can better inform you about EPS activities.



In the year since I last wrote this greeting for the 2010-11 newsletter, there have been many new developments. Among the faculty, we are very happy to welcome Dr. Yarrow Axford, who was identified as a target of opportunity hire last year and offered a tenure line Assistant Professorship this fall, which she accepted. Check out the article herein detailing Yarrow's story. The addition of a new colleague in 2011 was somewhat balanced, however, by the announcement that Abe Lerman will retire at the end of 2012, and that Cesca McNerney will resign in September 2012 in order to move to Australia. Fortunately, Professor Lerman will still be with us after he becomes emeritus, but we will sorely miss Professor McNerney who has been a wonderful colleague. The department will request approval for two searches next year in order to rebuild our active faculty ranks. Faculty members continue to be very busy in teaching, research

and service, with several performing important new roles outside the department. For example, Andy Jacobson accepted the job of Director of the Environmental Science Program, Neal Blair serves as the coordinator of environmental programs at NU and I continue to serve as the Associate Director of Education for the Initiative for Sustainability and Energy at Northwestern (ISEN). In October 2011 we held the official ribbon cutting ceremony for the Integrated Laboratories for Earth and Planetary Science (ILEPS). Although there was less fanfare associated with it, the past year has also witnessed significant developments for our geophysical computing operation, known as CREPS (Computational Research in Earth and Planetary Science). This facility is temporarily housed in a former lab in Locy until we can move to the Tech infill. We are extremely grateful to alum Bob Langan for his generous contributions of hardware for CREPS.

These stories and more can be found in this year's newsletter. We also include a section with news from alumni and we hope you will continue to send us updates of your activities. As in my past messages, I want to reiterate our deepest appreciation for the contributions our alumni have made this year – your gifts make our teaching and research programs possible and everyone in the department recognizes how lucky we are to have such supportive alumni. Thanks again, and we wish you health and happiness in 2012.

Cheers,

## EPS Brings Earth Sciences to Community Youth

*Contributions by Joseph Walkowicz, Karen Tekverk and Grace Johnson*

### NASA Capstone Course

For six high-school students and their teachers from south Chicago, the world expanded a little bit over five weeks this summer to include the joy of earth sciences. Through a joint venture between EPS and the Northwestern School of Education and Social Policy (SESP), organized by Dr. Patricia Beddows and Steven McGee, respectively, we welcomed the students and teachers to campus for our NASA-funded Capstone Course focused on earth system science and climate change. The daily research and analytical activities were managed by Joseph Walkowicz (EPS Class of 2011) and several of our current graduate students. The visiting high school students generated and used data from GPS, GIS and NOAA datasets, while also venturing out to Chicagoland institutions including the Botanic Garden and Field Museum. The experience culminated with a day-long poster session of the students' individual projects alongside sister NASA Capstone Course groups from the region. It is our vision that this kind of immersive and research focused educational outreach will

allow such bright high school students to see their future in the big world of earth sciences.

**Project EXCITE!** continues to engage young students with science through interactive experiments provided by EPS faculty and graduate students. In February of 2011, approximately 40 third- and fourth-grade students from the local Evanston community came to Locy Hall to learn about the role of carbon dioxide in the Earth's greenhouse effect. By exposing trapped atmospheres with different CO<sub>2</sub> concentrations to infrared radiation and measuring temperature change, the students were able to quantify the relative warming effect of CO<sub>2</sub>. They also recreated the thermal upwellings of deep sea hydrothermal vents in an aquarium. Finally, the students honed their quantitative skills by locating earthquake epicenters. Kourtney Cockrell, program coordinator for the Center for Talent Development commented that "EPS has been an incredible resource for Project EXCITE!. Students love learning about real world issues like global warming, and each year, they ask about when they're going back to EPS for more cool activities." We can't wait to have them back again, since we grow



as well by exciting the next generation of earth scientists.

### Seismology Shake

In May about 45 middle school students visited our halls to learn about earthquakes and seismology. They participated in a cooperative lecture on seismology, using the human body to demonstrate the difference between P-waves and S-waves. They simulated earthquakes by jumping in the stairwells and observing Locy Hall's seismometer readout, and used Google Earth to learn about earthquake locations and their relation to plate tectonics.

### Reach for the Stars

The Center for Interdisciplinary Explora-

## EPS Computational Facility

While celebrating the Department's brand new analytical facility ILEPS, we now also acquired a new computational facility, named CREPS for Computational Research in Earth and Planetary Science. Professor Suzan van der Lee championed the effort to develop a robust EPS computational infrastructure that would be easy to access and navigate by graduate students. She was joined by other geophysics faculty members in securing a grant from the National Science Foundation (NSF) for the purchase of CREPS, which includes a research and development cluster. The cluster is a small rack of dedicated multi-node, multi-core equipment which provides fast parallel computing for data processing and analysis as well as modeling. It also includes a back-up server.

While the R&D cluster is at the heart of the system, Van der Lee points out the important roles played by the other components of CREPS: a research and training computing lab with iMac workstations that are identically equipped with geophysical software - much of it developed by current and former Department members - to promote sharing, cooperation, and teaching. The lab's capabilities are augmented by EPS alumnus Bob Langan (Ph.D. 1981) who generously donated three Linux workstations and one workstation is now equipped with ESRI GIS software. A new course, EARTH322, Computer Methods in EPS, was taught in this lab in the fall of 2011. The stations also serve as a gateway and post-processing platform for the EPS' R&D cluster as well as Quest, the University's high-performance computing system.

CREPS is primarily but not exclusively used by students and faculty in geophysics and is accessible to all EPS members.

A final component of CREPS includes our Education and Outreach Display in the hallway of Locy Hall, which includes a touch screen for interactive engagement with Earth Science concepts - powered by IRIS - and a live stream of data from a demonstration seismometer in the basement of Locy Hall. In addition to earthquakes, we record jumps of visiting alumni! Please let us know when you're in town so we can record and add your footprint to our collection of notable events.



## Integrated Labs of EPS Opened its Doors with an October Ribbon Cutting

tion and Research in Astrophysics (CIERA) selected graduate student Emily Wolin for the National Science Foundation-funded Reach for the Stars Fellowship. This NSF program places STEM graduate student fellows in K-12 science classrooms for the academic year with the goal of enriching their educational experience and strengthening student development as researchers by advancing communication and teaching skills. Wolin is working in Marie Breitenstein's sixth-grade classroom at Chute Middle School in Evanston to help students craft research questions and look for solutions using computational models. "The program puts you in a classroom so the class can benefit from your knowledge and you can benefit from the teacher helping you with communication skills and teaching. I know it's helped me," Wolin said. "I can't wait to go back and TA and see how that works." Through Reach for the Stars, GK-12 fellows will adapt concepts of computational thinking and actual computational modeling tools from their research work to classroom activities connected to the existing math and science curriculum.

On the 24th of October, 2011, the Department of Earth and Planetary Sciences and members of the NU administration (President M. Shapiro, Provost D. Linzer, Associate Provost J. Shedd and VP-Research J. Walsh) gathered to commemorate the completion of the Integrated Laboratories for Earth and Planetary Science (ILEPS). The approximately 8,850 square-foot lab facility, located in newly renovated space on the 3rd floor of the O.T. Hogan Building, has been in the making for over 5 years. The renovation itself reflects an investment of about \$10M by the university, with perhaps another \$1M contribution from NU for instrumentation and other forms of support. The analytical labs support the research of faculty members Neal Blair, Matt Hurtgen, Steve Jacobsen, Andy Jacobson, Cesca McInerney and Brad Sageman, and have become a center of bustling research activity serving the needs of visiting scientists, post doctoral scholars, EPS graduate students and undergraduate majors. The ILEPS facility finally started to achieve its potential when the last renovation details and instrument installations were completed in August of 2011. The facility includes one of the most modern and high-tech geochemical clean labs on the planet, built by the German company PicoTrace, which is part of the complex housing the NSF-MRI funded Thermal

Ionization Mass Spectrometer operated by Dr. Andy Jacobson. Other highlights include the Stable Isotope lab which houses two Thermo Scientific Delta V isotope ratio mass spectrometers capable of analyzing stable isotopes of H, C, N, O, and S through a variety of preparation systems, and the Mineral Physics lab which features a suite of diamond-anvil cells capable of maintaining static high pressures in excess of 100 Gigapascals and a variety of ultrasonic, spectroscopic, and structural probes for *in situ* analysis of materials under high pressure and temperature conditions.



## Chevron and Shell – Recruiting Bright Minds from EPS

The bright minds in EPS continue to impress our alumni recruiters Phil Richardson (Ph.D. 1998) and Michael Fortwengler (MS 2004), who arrived from Chevron and Shell respectively. Last summer Xiaoting Lou and Miguel Merino completed rewarding internships at Chevron. Xiaoting welcomed an offer of a permanent position that he will take upon completion of his Ph.D. this June. Miguel Merino plans to return next summer and will be joined by Trevor Bollmann for more exciting work as Chevron interns.

## Cohen Family Fund Supports EPS Teaching & Outreach

The Ken Cohen Fund for Energy and Environmental Studies was established in 2002 through the generosity of Kenneth P. Cohen and Darcie A. Bundy to support programs focusing on global energy issues and to fund visiting lecturers in related disciplines. In 2011 the Cohen Fund supported one of the most important earth science experiences that undergraduate and graduate students can have: EARTH 331–Field Problems in Sedimentary Geology. This course involves a 3.5-week field excursion to Colorado and Utah and provides an intensive immersion experience in field geology, sedimentary facies analysis, and sequence stratigraphy. These are some of

the key skill sets that prepare students for careers in the energy industry.

The Cohen Fund also helped to support the acquisition of a climate station for the Evanston campus that is associated with Professor Andrew Jacobson’s project to monitor the “urban metabolism” of the Chicagoland area (see

<http://nuco2.earth.northwestern.edu/> for details), and funds will be used this coming March to help support visiting lecturers on topics related to energy use and climate change at our 3rd annual Climate Change Symposium. The department is extremely grateful for the support provided by the Ken Cohen Family Fund.

## Changing Role for EPS in Environmental Programs



The Environmental Science Program of the Weinberg College of Arts and Sciences (WCAS) was initiated in the late 1980’s by Earth and Planetary Science (EPS) faculty members Seth Stein, Donna Jurdy, and John Walther. It was designed to offer undergraduates a basic science curriculum with a selection of upper level courses focused

on environmental issues. Recently, Professor Neal Blair (joint appointment in EPS and the Department of Civil and Environmental Engineering) was appointed to a new position coordinating the various environmental programs at Northwestern. These programs include the Environmental Science major within WCAS, the Envi-

ronmental Policy and Culture social sciences minor focused on environmental issues, and the Environmental Engineering undergraduate program in the McCormick School of Engineering. In addition to Professor Blair’s new position, Professor Andrew Jacobson of EPS has been appointed director of the Environmental Science program in WCAS. In addition to Dr. Blair’s teaching contributions to the Environmental Science program (ENV\_SCI 203 and a new course in Geographic Information Systems), brand new EPS faculty member Yarrow Axford will take over the teaching of ENV\_SCI 201 in the Spring. As a result of these changes, the role that EPS plays in supporting environmental programs at Northwestern has significantly expanded over the past year. Combined with our contributions to the Initiative for Sustainability and Energy at Northwestern (ISEN), the department is well-positioned to help Northwestern achieve key goals outlined in the most recent strategic plan for the university.

## Amazing Undergraduates!

Our declared undergraduate majors now number twenty seven, the largest major pool in decades, and they are doing amazing things! Students have completed summer research internships in leading research institutions, and they have benefited from valuable learning beyond the classroom, all of which support their future careers.

**Clayton Brengman** worked over the summer on the SPREE program with Dr. Suzan van der Lee’s team installing seismometers as part of the continent-wide array...**Peter Carlson** returned from a semester at the University of Otago where he gained academic and field experience in the most diverse geology

of New Zealand, and is now researching the implications of gypsum in soft lake sediments in relation to drought cycles...**Alice Carter** completed a summer position in Dr. Ken Buesseler’s lab at Woods Hole Oceanographic Institute (WHOI) focused on exopolymer particles “marine gels” that form particle aggregates...**Alice and Ekjyot (Joey) Gill** are now both supported by Undergraduate Research Grants through the Office of the Provost, with Joey working on the role of fungi on rock and mineral weathering, and Alice developing a multi-proxy paleoenvironmental record of coastal change at a Maya archeological site...**Catherine Carrio’s** exciting

research uses fossil chironomic midges preserved in arctic sediments to reconstruct past conditions...**Ben Heath’s** summer research at the Graduate School of Oceanography, University of Rhode Island, used satellite altimetry data to locate eddy formation and eddy sinking in the northwest North Atlantic...**Matt Strumpf** is now happily researching properties of teeth apatite with an eye of applying to dental school in the coming year...**Laura Beckerman** has created an *ad hoc* major in Astrobiology which includes classes in EPS, biology, and chemistry. This summer, Laura analyzed carbon isotopes of Mars analog materials at NASA Goddard Space Flight

*Continued on page 11*



## Dr. Yarrow Axford joins faculty

About a year and a half ago, Dr. Yarrow Axford began a two-year appointment as a visiting assistant professor in Earth and Planetary Sciences. Although her appearance at Northwestern was coincidental, it very soon became apparent that Axford was a rising star in her field and a fantastic colleague. As a result, the department was able to request a target

of opportunity tenure track appointment at the rank of assistant professor. Dr. Axford brings research expertise to EPS that is highly complimentary with our existing efforts in the study of biogeochemical cycles and paleoclimate, but she also expands our scope to the most recent phase of Earth history. Axford is a paleolimnologist and Quaternary paleoclimate expert whose work focuses on lake sediment records of arctic and alpine environments. The department is thrilled to have Dr. Axford join our ranks.



## EPS Welcomes & Goodbyes

**EPS welcomed** three new graduate students this fall; **Ashley Gilliam**, **Amir Salaree**, and **Michael Witek** (See pages 9-11 for more information about them), a growing group of undergraduate majors, and three babies! Professor Francesca McInerney gave birth to **Owen Peter** last February, Research Technician, Petra Sheaffova, gave birth to **Jakub Logan** in July, and postdoctoral researcher Chris Junium became father to **Charles** in October. Undergrad alumnus **Alexa Socianu** joined the EPS Sedimentary Geology Lab and Rock Prep facility staff.

**Goodbyes...** Postdocs **Chris Junium** and **Joel Moore** (who worked for Matthew Hurtgen and Andrew Jacobson respectively) moved on to faculty positions. Chris joined the Syracuse University Department of Earth Sciences, and Joel joined Towson University Geosciences, both as Assistant Professors. **Rich Barclay**, **Derek Adams** and **Simon Lloyd** completed their Ph.D.s in 2011. After leaving Evanston, Rich held a postdoctoral research position in Dublin, Ireland, and then moved to Washington D.C. in late 2011 to start a three-year fellowship

at the Smithsonian. Derek joined the Chevron staff in Houston, TX, and Simon Lloyd is doing postdoctoral research at the University of Vienna, Austria. EPS also said goodbye to undergraduate majors **Joseph Walkowicz** (now doing graduate study at U. Chicago), **Kristen Bartucci** (who is pursuing graduate coursework at Loyola University Chicago), and **Alexa Socianu** (who became a member of our laboratory staff). We also said goodbye to Stable Isotope Lab manager **Kelly Peeler**, who has moved to Virginia Polytech.

## Faculty Highlights



**Yarrow Axford** is a Quaternary geologist and paleolimnologist. Much of her current research involves analyzing lake sediment records to reconstruct Holocene and current climate change in the

Arctic. Yarrow is planning a summer 2012 field season around Thule in northwest Greenland, where she and collaborators from Dartmouth College will begin work on a new NSF-funded project combining lake coring with glacial geology and ice coring. The objective is to understand how glaciers in northwest Greenland responded to past climate changes. As a new faculty member, Yarrow is looking forward to recruiting graduate students, teaching new courses and getting her analytical lab up and running...



Last spring, **Patricia Beddows** cored sediment at the Maya port city of Vista Alegre. Alice Carter (EPS+ISP 2012) is now using these sediment cores to reconstruct the coastal environment that supported the

poorly understood Maritime Maya. Visit <http://oceanexplorer.noaa.gov/explorations> to read more about these NOAA "Ocean Explorer Signature Expeditions". Peter Carlson (EPS+ISP 2012) is also working with Patricia to better understand the mineralogical signature of drought captured in Belize lake cores retrieved in 2010. The exciting video "Diver Vanishes" which documented this earlier expedition reached #2 on the National Geographic webpage. Patricia is also thrilled to begin work with Ph.D. student Emiliano Monroy-Rios who arrived in January 2011. Emiliano will be working to provide new insight on elemental fluxes from carbonate platforms in a warming world with rising sea level conditions...**Craig Bina** recently visited Mark Robinson at Arizona State University, with whom he is beginning to study some questions of lunar structure. He was a visiting

researcher at Charles University in Prague, in the Czech Republic during the Fall Quarter of 2011, where he continued to pursue work related to deep mantle structure, composition, and dynamics...

**Neal Blair's** Biogeochemistry Laboratory along with collaborators from North Carolina State University, SUNY-Stony Brook, and GNS Science of New Zealand, has pioneered approaches to track the fate of soil organic carbon as material is



eroded, delivered by rivers to the ocean, and transported across the seabed. Field areas have included Northern California, New Zealand, Papua New Guinea and

the Amazon River. A new project focuses on tracking terrestrial carbon into subduction zones. The Blair laboratory has also undertaken a new direction of research involving the role of fungi in the soil carbon cycle. This work is in collaboration with Louise Egerton-Warburton of the Chicago Botanical Garden. The focus is on whether soil fungi produce novel organic materials that contribute to carbon storage or may be effective at converting plant debris to potential biofuels...

**Matt Hurtgen's** research group seeks to identify the complex set of processes that regulate photosynthetic organic carbon production in marine surface waters and Earth surface oxygen concentra-



tions. To investigate these processes, he studies modern and ancient sedimentary systems, integrates field observations with a variety of geochemical tools, and combines these efforts with simple geochemical models. Towards this end, Hurtgen, along with graduate student Maya Gomes and faculty colleague Brad Sageman, spent two weeks in northern



*Craig Bina near Oslo, Norway*



*Patricia Beddows in Mammoth Cave*



*Mountain range in southern France*



*Petrology field trip to the UP at Jasper Knob, Ishpeming, MI. The group teamed up with faculty and students from Notre Dame. Photo by Laurel Childress.*



*Earth 201 field trip to Baraboo, WI*



Italy and southern France measuring stratigraphic sections and collecting Cretaceous-aged carbonates and shales for geochemical analysis. This work seeks to test the hypothesis that massive volcanism may have triggered a biogeochemical cascade that led to higher rates of photosynthetic organic carbon production within marine surface waters, and ultimately widespread deep ocean anoxia. Graduate students Jeremy Gouldley and Brian Kristall continue their efforts to understand the role that sulfur plays in regulating Earth surface redox conditions in the Neoproterozoic and early Cretaceous, respectively. Additionally, Hurtgen and Sageman spent four weeks camping in the wilds of Colorado and Utah teaching field stratigraphy to a group of Northwestern undergraduate and graduate students. They are happy

to report that everybody survived!...



**Steve Jacobsen's** research in mineral physics deals with the materials science of Earth and planetary processes. He and graduate students are currently studying the behavior of

volatiles (such as hydrogen and carbon) dissolved into minerals and silicate glasses, physical properties of materials at extreme conditions, cement mineralogy, and spectroscopy of planetary ices. In 2011, Jacobsen gave an invited talk to the National Nuclear Security Administration's review panel of the Carnegie/DOE Alliance Center, which supports much of the group's research at Argonne National Laboratory. Jacobsen also gave an invited talk to the NSF-IF review panel to build support for a new high-pressure synchrotron-infrared beamline at the National Synchrotron Light Source ([www.bnl.gov/nsls2](http://www.bnl.gov/nsls2)), now under construction at Brookhaven National Laboratory. In

May 2011, Jacobsen led a field trip with his petrology class to the UP of Michigan...

**Andrew Jacobson** uses isotopic methods to study climate change. 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. In September 2011, Jacobson finished building his metal-free clean laboratory and installed his thermal ionization mass-spectrometer funded by the NSF-MRI program. Jacobson is also using a state-of-the-art laser spectrometer to measure the concentration and sources of CO<sub>2</sub> in Chicago's atmosphere. Information about the project is available at <http://nuco2.earth.northwestern.edu...>



**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 students Kim Adams and Ashley Gilliam study Titan, a most enigmatic satellite of Saturn. They are examining the distribution and sizes of pits, abundant depressions on Titan's surface. Also, a study is underway of Titan's mountains and lakes and possible relation to a sub-surface ocean of methane and ethane. Along with Renee French, the geology of the Meridiani region of Mars is being examined for evidence of tectonic activity...



**Abraham Lerman**, co-author of the recently published Carbon in the Geobiosphere, is studying the interactions of global climate change

with the biogeochemical cycles of life-essential elements. The coupled carbon-nitrogen-phosphorus-silicon biogeochemical cycles interact with changes in the atmosphere, land, and ocean that are caused by natural and human processes, and in turn modify them. Lerman, along with his collaborators and graduate students, have identified such processes as the times of reversal in

the air-sea CO<sub>2</sub> exchange of the shallow coastal and open ocean, the limiting role of phosphorus in biological production on land and control of atmospheric CO<sub>2</sub> 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. By examining modern plants, she and graduate student Rosemary Bush are establishing how environment and plant type control the abundance and isotopic signature of leaf wax lipids. These same leaf

waxes can be analyzed from periods of climate change in the geologic past such as the Paleocene-Eocene Thermal Maximum (PETM). McInerney and graduate student Allie Baczynski are examining PETM leaf waxes both from outcrops and from subsurface cores drilled during the summer of 2011 as part of the NSF funded Bighorn Basin Coring Project (<http://earth.unh.edu/clyde/BBCP.shtml>). In addition, McInerney and Bush are beginning a new NSF funded project in Ethiopia with colleagues Ellen Curran, Bonnie Jacobs and others that will examine climatic and ecological change during the Neogene...

**Emile Okal** participated in the field survey of the catastrophic Tohoku tsunami



on the Indonesian part of the island of New Guinea. During the event itself, he happened once again 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 was invited to lecture at a number of conferences in Austria, Germany and Puerto Rico, and is also working on an informal project to per-

manently preserve world-wide archives of historical seismograms...

**Brad Sageman (Chair)** was quite busy in the past year with chair-related administrative work, including completion of the Hogan lab renovation (see separate article pg. 3), continued work on the



Tech infill project (our new offices), and negotiations to secure a new faculty line for Dr. Yarrow Axford (see separate article pg. 5). Brad's main research focus in 2011 was completion of two papers with colleagues from UW-Madison on revised time scales for the Cenomanian-Turonian and Turonian-Campanian stages based on integration of new radioisotope dating and astronomical time scales from the Western Interior U.S. These studies will form the basis for the Cenomanian through Santonian intervals of the revised Geologic Time Scale. Field work in Italy and France focused on sampling Cretaceous OAE's as part of a continuing collaboration with colleague Matt Hurtgen. In addition to the European jaunt, Matt and Brad taught EARTH 331 last summer, with the requisite 3.5 week field excursion through Colorado and Utah – 2011 was the best year yet for the field course! In 2011 Brad also continued work on sustainability and environmental issues on campus through his role as Associate Director of Education and Special Projects for ISEN (the Initiative for Sustainability and Energy at Northwestern) and as one of the organizers and instructors of the Environmental Field School...

**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** continues to

investigate the Earth's mantle, with a present emphasis on the lithosphere of North America. Graduate student Xiaoting Lou presented a new mantle model for North America at the fall AGU meeting, and he is still testing it voraciously on our



new research cluster. Emily Wolin, Trevor Bollmann, and Jessica Lodewyk each presented a poster at the AGU meeting on our seismic experiment in the Mid Continent Rift region: SPREE. The posters covered wave propagation through the continental interior lithosphere-asthenosphere system from the Virginia earthquake to SPREE stations, teleseismic travel-time delays in the SPREE study region, and finite-volume, finite-frequency sensitivity kernels for lithospheric head waves. New graduate student Michael Witek has embarked on efforts to model ground motion noise in North America and beyond. Undergraduate students Ben Heath and Clayton Brengman have investigated the causes of noise on the Locy Hall seismometer and its earthquake detection limits.



*USArray Data Processing Short Course participants*

## Graduate Student News

**Kimberly Adams** has been traveling to the National Synchrotron Light Source at Brookhaven National Labs in New York to complete her work on the visible and near-infrared reflectance of methane, ethane, and hydrocarbon mixtures at low temperatures. These measurements can be used to determine the physical state of hydrocarbon lakes on Titan. Her paper entitled "Optical reflectivity of solid and liquid methane: Application to spectroscopy of Titan's hydrocarbon lakes" will be published in *Geophysical Research Letters*...**Allie Baczynski** spent the summer working on the Bighorn Basin Drilling Project in Wyoming. They collected cores at three sites, targeting two episodes of abrupt, large-magnitude global warming: the Paleocene-Eocene Thermal Maximum and the Elmo event. In January she headed to Germany as part of the scientific team to describe and sample the cores at the IODP Bremen Core Repository. The Bighorn Basin cores will provide unprecedented sampling resolution across these two global climatic events in order to better understand their causes and effects...**Trevor Bollmann** is currently working with Suzan van der Lee collecting teleseismic delay times for the area surrounding the Mid-continent Rift. He is also doing a project with Brad Sageman to map the evolution of the Wyoming Craton through time...**Rosemary Bush** won an award for best student presentation for her poster on fossil n-alkanes at the Climate and Biota of the Early Paleogene conference last June in Salzburg, Austria. She also attended a conference for current EPA Fellows in October in Washington, D.C. where she was hosted on Capitol Hill and had the chance to visit the offices of the House representatives. (She met with a staffer of her Texas state representative, John Culberson.) In December she traveled to Ethiopia with several researchers from other universities to collect plant fossils from the early Miocene in the Ethiopian highlands...**Yun-Yuan Chang** attended the SSAA/NNSA meeting and presented her work on "Electronic Spin Transition of Iron in Dense Hydrous Magnesium Silicate at High Pressure". At the Fall 2011 AGU meeting, she gave a talk on that topic and discussed the effects of

Fe spin transition on the compressibility of dense hydrous magnesium silicate, phase D. She finished the measurements of Type Ia diamond and plans to measure other types of diamonds and other superhard materials...Third-year student **Laurel Childress** focuses on biogeochemical cycles, specifically the transport, transformation, and burial of organic carbon. Additionally, her research tracks organic carbon into active margin related subduction zones using a high temperature-high pressure diamond anvil cell, coupled with Raman spectroscopy. Laurel participated in an Early Career Investigator Oceanographic Research Training Cruise last fall off the Columbia River, and was invited to participate in an Integrated Ocean Drilling Program expedition to Alaska



in 2013 as an organic geochemist...**Carl Ebeling** presented work supported by his NSF Graduate Research Fellowship at the 2010 Fall Meeting of the American Geophysical Union ("Identification and Characterization of Several Hurricanes Using Microseisms") and the 2011 Geological Society of America annual meeting ("Seismic Identification of Hurricanes: Seeking the Signal Needle in the Noise Haystack"). As first author, and with Dr. Emile Okal and two other coauthors, he has written a manuscript entitled "Modern Seismological Assessment and Tsunami Simulation of Historical Hellenic Arc Earthquakes". It has been submitted to the journal "Tectonophysics." He is the sole author of "Inferring Ocean Storm Characteristics from Ambient Seismic Noise: A Historical Perspective", submitted to "Advances in Geophysics". Carl was awarded the 2011 Department of Earth and Planetary Sciences Horace A. Scott Graduate Award given in recognition of outstanding research accomplishment and potential...Second year student

**Renee French** has been researching the magnetization of Terra Meridiani, Mars (where the Opportunity rover landed) with Donna Jurdy. They plan to characterize its source and compare it to other magnetized regions on the red planet. Other research with Craig Bina involves determining the formation of extensional features on the Moon, a body that should be globally contracting. This project is part of collaboration with Mark Robinson and his research team at Arizona State University where data from the Lunar Reconnaissance Orbiter Camera (LROC) is headquartered. Her next target of inquiry is Mercury...First-year student **Ashley Gilliam** published a paper in *Planetary and Space Science* titled "Titan under a red dwarf star and as a rogue planet: Requirements for liquid methane," co-authored with Dr. Christopher McKay (NASA Ames Research Center). In close collaboration with NASA and Professor Donna Jurdy, she plans on expanding her investigation of Titan and the surface indicators of a possible subsurface ocean...

**Maya Gomes** is a NASA Earth and Space Science graduate fellow who examines sulfur isotope fractionation in modern low sulfate systems in order to better understand how the chemistry of the ocean in the Precambrian changed in response to the early evolution of life on Earth. Recently, she has started to apply what she has learned from modern systems to another period in Earth history when it is thought sulfate levels in the ocean were low: the Cretaceous. This summer she traveled with her advisor, Matt Hurtgen, and project collaborator Brad Sageman, to Italy and France to obtain samples from Cretaceous age Oceanic Anoxic Event intervals. She will be analyzing these samples for sulfur isotope geochemistry in order to better understand fluctuations in the sulfur cycle during this critical greenhouse time period...**Jeremy Gouldley** is a fourth year student working on reconstructing the isotopic evolution of carbon and sulfur during the Cryogenian interglacial interval (between the two Snowball Earth glaciations) in order to examine sulfate concentrations and explore ancient biogeochemical relationships. He gave a talk at the 2011 AGU General Meeting titled "The Role of Sulfur on Major Fluctuations in the Carbon

Cycle During the Neoproterozoic Interglacial Interval”, and is working on publishing his second paper...**Young Ji Joo** compiled new Late Cretaceous stable carbon isotope data in the Western Interior Basin. These well-preserved isotope records not only provide a robust framework for regional and global correlation of Cretaceous strata, but also reveal the dramatic changes in the global carbon cycle during that period. Joo presented her new results at the 2011 Goldschmidt conference and the 2011 GSA meeting. Also, last July, she participated in U.S. Advisory Committee for Scientific Ocean Drilling (USAC) meeting in Washington D.C., and

presented her work as a 2010-2011 Schlanger Fellow...**Brian Kristall** is investigating the role the sulfur system plays in the evolution of ocean chemistry. He will be looking at the Early Cretaceous when several large igneous provinces, massive evaporites, and oceanic anoxic events caused major changes in the global sulfur cycle. In addition, he will be looking at the influence of seafloor hydrothermal systems and the formation of massive sulfide deposits had on the global sulfur cycle...**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. Greg travelled to

Fairbanks, AK to retrieve several frozen permafrost cores for analysis. He also spent 3 weeks at the University of Saskatchewan Stable Isotope Laboratory in Saskatoon, running calcium isotope samples on the Thermal Ionization Mass Spectrometer. In October, Greg presented his research at the EPA STAR Graduate Fellow Conference in Washington D.C. ...**Dan (Darcy) Li** is working with Professor 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 ocean, especially by human perturbations. She is also working with

## Graduate Student Awards

*We are thrilled to report that a number of graduate students in the department have received awards for their various accomplishments. They include:*

**Laurel Childress.** Laurel was selected to participate in the Early Career Investigator Oceanographic Cruise to explore organic carbon dynamics in active margin sites this past September.



The goal of this program is to instruct early career marine scientists how to effectively plan for,

acquire, utilize and report on time at sea for multi-disciplinary research and education. Excitingly, she was also invited to participate in an Integrated Ocean Drilling Program expedition off the coast of Alaska as an organic geochemist in 2013...**Carl Ebeling.** Carl was awarded



the 2011 Department of Earth and Planetary Sciences Horace A. Scott Graduate Award given in recognition of outstanding research accomplishment and potential. In particular, Carl submitted two first-authored manuscripts in the past year (see pg.9)...

**Miguel Merino.** Miguel was awarded a scholarship from the American Geoscientists Institute Minority Participation Pro-

gram. The goal of this program is to develop the professional corps of underrepresented ethnic-minority students in the geosciences...

**Jessica Lodewyk.** Jessica was funded



by the NSF EAPSI (East Asia and Pacific Summer Institute) Fellowship to spend the summer at Academia Sinica in Taiwan. She was privileged to work with Dr. Li Zhao learn-

ing a new computational method, called finite frequency sensitivity kernels, which provides better resolution tomography models...

**Emiliano Monroy-Rios.**

Emiliano was awarded a highly competitive graduate research fellowship from CONACYT—the NSF of Mexico. The goal of his research will be to gain new insight on how rising sea levels may affect elemental fluxes from carbonate platforms...



**Josh Townsend.** Josh won the 2012 Mineralogical Society of America E.H.



Kraus Crystallographic Research Award for his proposal entitled “Extra-solar planetary mineralogy: the role of H<sub>2</sub>O in crystal structures.” The \$5000 grant targets projects within the areas of min-



eralogy, crystal chemistry, petrology, mineral physics, biomineralization, and geochemistry for which research bearing on crystal structure is an explicit and integral element...

**Emily Wolin.** NU’s Center for Interdisciplinary Exploration and Research in Astrophysics, CIERA, selected Emily as the recipient of a National Science Foundation GK-12 fellowship, *Reach for the Stars.*

This program places STEM graduate student fellows in K-12 science classrooms for the academic year with the goal of enriching their education and strengthening their development as researchers by advancing their communication and teaching skills. Emily works in partnership with teachers at Evanston’s Chute Middle School to bring more inquiry-based teaching methods into the classroom and to further expose K-12 teachers and students to the research process.



Professor Andy Jacobson on a reactive transport model to investigate tectonic and climatic controls on weathering fluxes on a regolith profile scale. She was invited as a junior scientist to attend a C-cycle conference and workshop in Brussels, Belgium 4–7 October, endorsed by the Global Carbon Project and by the International Geosphere-Biosphere Programme (IGBP)...**Jessica Lodewyk** is a second year graduate student working with Professor Suzan van der Lee. She conducted research in Taiwan (see awards story pg. 10) She was also active in SPREE fieldwork, venturing out to Minnesota and Wisconsin with Emily Wolin and Miguel Merino to install and service seismic stations...**Xiaoting Lou** has developed a Python/Matplotlib tool to measure teleseismic P and S relative arrival times from IRIS PASSCAL and EarthScope USArray data. Velocity variations within the North American mantle are investigated by a joint inversion of body wave travel time measurements and regional surface waveform constraints. His results suggest that the mantle beneath the US east of the Rocky Mountains is as heterogeneous as the mantle beneath the US west of the Rockies. He is also working on effects of hydration on mantle elasticity by modeling and comparison with seismology...**Miguel Merino** presented his work on intraplate earthquakes, and the rifting processes at two conferences last year, and has been invited to give a talk at an international conference in Gujarat, India. His second paper entitled "Mantle flow beneath Arabia offset from the opening Red Sea" was published by Geophysical Research Letters in February 2011. Miguel was awarded a scholarship from the AGI Minority Participation Program to help further his research. He also worked for Chevron in the summer of 2011 and has accepted another internship for the summer of 2012. Research plans for 2012 include gravity modeling of the Mid Continent Rift to be compared with the seismic results from SPREE and continued work on intraplate earthquakes...Second-year student **Emiliano Monroy-Rios** is interested in water-rock interactions and the geochemistry of coastal carbonate aquifers. The samples that he collects for geochemical analysis are obtained from the underwater cave systems in the Yucatan

Peninsula, Mexico, using cave diving techniques. Emiliano's research is support in part by a CONACYT grant from the Mexican government...First year student **Amir Salaree** is interested in investigating different characteristics and mechanisms of deep and intermediate-depth earthquakes. Because anisotropies in the earth's mantle affect the radiation path of earthquake waves, evaluation of these characteristics involves many different approaches and concepts (e.g. structural, seismological, thermodynamics, etc) which require a variety of evidence provided through different studies, making it a multidisciplinary field of research...Second year student **Karen Tekverk** did her undergraduate thesis analyzing the potential for early life in the Abitibi Greenstone Belt. At Northwestern, Karen is working on a project in geophysics and the Mid-Continent Rift System, but is also hoping to develop work in geoscience education over the course of the year, focusing on high school and undergraduate-level science students...**Joshua Townsend's** research is focused on combining experimental techniques for measuring hydration of silicates at extreme pressures and temperatures with first-principles crystal structure modeling. Currently, he is developing new experimental techniques for measuring hydrogen in minerals via synchrotron infrared light, and applying those techniques to a newly discovered high-pressure silicate called "post-perovskite" which may exist in the lowest parts of Earth's mantle, and in the mantles of rocky exoplanets. The applications of this work include the potential habitability of other worlds. Townsend won the 2012 Mineralogical Society of America E.H. Kraus Crystallographic Research Award. His proposal was entitled "Extra-solar planetary mineralogy: The role of H<sub>2</sub>O in crystal structures..."**Emily Wolin** continues to



pursue her interests in the structure and evolution of stable continental regions. In the spring of 2011, she helped deploy 21 SPREE stations in Wisconsin and Minnesota. Service runs in June and October recovered high-quality data, including beautiful records of the M 5.8 Mineral, Virginia earthquake. She is beginning to fit S and surface waveforms from this and other earthquakes within continental North America, with the goal of producing a high-resolution tomographic model of the Mid Continent Rift and surrounding region. Emily traveled to Washington, DC in September to participate in a showcase of NSF-funded natural hazards research on Capitol Hill. See preceding page to learn about Emily's NSF GK-12 fellowship...**Michael Witek** is a first year student interested in seismic tomography imaging of the Earth's crust and mantle. Seismic waves travelling through the Earth are affected by the Earth's structure, and analysis of these waves can be done to construct a three-dimensional model of the crust and mantle. He will be working with Prof. Suzan van der Lee to develop a research project in this field.

*Undergraduate Research continued from page 4*

Center...**Ellie Bensinger** is a double major with Theatre with a Certificate in Musical Theatre, and aims to secure a position with the National Park Service or teach geology...



The 3.5 week Field Problems in Sedimentology course provided intensive field learning for **Caroline Binkley**, along with a number of graduate and undergraduate students...**Harry Hahn** also benefited from a semester at Otago University, NZ, and completed an independent study focused on soils and vegetation at the abandoned Wangaloa Coal Mine in order to support rehabilitation of similar sites. **Nora Richter's** summer was at the Environmental Science Division at Argonne National Laboratories developing a software tool to quantitatively assess the performance of hydropower operations, with implications for evaluating downstream site objectives. We could not be more proud of our undergraduates, and congratulate them on their accomplishments.

## Alumni News

**Derek Adams** Ph.D. 2011-Employer: ExxonMobil, Title: Senior Petroleum Geologist. I work in the Development Company which takes over trying to understand a resource after it's found and handed off to us by the Exploration Company. We build a geologic model which is then used to make big financial and infrastructure/engineering decisions. Also, the Development Company drills additional wells to better constrain how much oil/gas is there and where it's located. My day to day work primarily involves seismic interpretation with a few other projects thrown in on the side. This year our team will be drilling at least two more wells so I'll be helping to support Operations and will travel out to the rig (in the Gulf). Something interesting is



that Kim and I just got back from a 12-day trip traveling all over India! It was an amazing and unforgettable experience.

**Rich Barclay** Ph.D. 2011 - After graduating, I spent 6 months in Ireland as a post doc at University College Dublin, working with Jennifer McElwain to reconstruct CO<sub>2</sub> during the Carboniferous time period. I just started as a post doctoral fellow at the Smithsonian, National Museum of Natural History, in Washington D.C. I am a Peter Buck Fellow, and will be here for 3 years working on reconstructing CO<sub>2</sub> during the Paleocene Eocene Thermal Maximum...

**Heather Beadle** Ph.D. 2008 - I did get a promotion at Chevron, and moved to a different position where I am doing both geology and geophysics, so it has been a nice mix. Although, they took two people off the team, and replaced them with just me, so I'm doing the work of two people - which is stressful at times.

I'm working a field that is in the deep-water Gulf of Mexico... its right on the shelf edge, so the sands the hydrocarbon are in are turbidite deposits. So, I've

had to start learning more about turbidites, which is interesting. But, being in deepwater now means I won't get to drill as much... our field drills only about one well a year, so maybe next year I'll be able to get a well drilled!...

**Martin Lee Collin** BS 1963- Following graduation from NU with a Bachelor's in Geology, I received an MSc at West Virginia University (Thesis: Vermiculite development at acidic dike intrusions into basalt in Maryland and Delaware), and a PhD from West Virginia University (Dissertation: Accumulation of toxic mine drainage in montmorillonite lake-bottom sediment of the Tygart Reservoir from a seemingly pristine stream inlet perched above the water table). I then became the Natural Environment Planner of



the State of Maryland for the Baltimore Metropolitan Region, and in charge of Baltimore Harbor Renovation. For 23 years following that, I was in charge of all land-use alteration applications that might affect groundwater quality in Israel for the Hydrological Service and Water Commission. After receiving my certification from Cambridge University (UK) as a Teacher of English as a Foreign Language (TOEFL), and following retirement after 30 years in environmental land-use planning, I've become a full-time English Instructor in Israel...**Charles DeMets** Ph.D. 1988, of the University of Wisconsin, has been elected an AGU Fellow. The citation reads "For determination of global plate angular velocities, of motion across subduction zones and diffuse oceanic plate boundaries, and of Pacific-North America plate motion..."

**Fritz G Nagel** MS 1951 - Retired: My family and I spent three days recently on the Island of Hawaii. During a tour by helicopter I viewed the spectacular volcanic geology and its impact on terrain and

human occupancy...**Adabell Karstrom Phillips** M.S. 1950 - We're still alive and kicking but had to give up sailing our 35' Hunter for lack of mobility and gave it to our daughter in CA, caused a major adjustment to our lifestyle...

**Brian Shiro** BA 2000 - I work for the NOAA Pacific Tsunami Warning Center in Ewa Beach, Hawaii, and have been intimately involved with the response to numerous tsunamis such as the recent Japan 2011, Chile 2010, and Samoa 2009 events. My wife Holli (also a NU alumnus) and I have two children: Henry (born 2007) and Isla (born 2011). We are all doing well...

**Janice Carr Smith** BA 1977 - I am the Sr. (only) Environmental Compliance Specialist for County Public Works [Lewiston, CA] - make sure all the County's projects are done right. I also regulate and inspect all the mines in the County...**John Snyder** Ph.D. 1957 - "I'm enjoying documenting experiences from the past." John sent EPS *The Queen Interrupts*, which describes a time he and his students saw an unusual sight from the windows of Locy Hall: The British Royal Yacht, *Britania*. Read the full story on the EPS website at:

[www.earth.northwestern.edu/alumni/index.html](http://www.earth.northwestern.edu/alumni/index.html)...

**Lingling Wu** Ph.D. 2008, accepted a tenure-track Assistant Professor position in the Department of Earth and Environmental Sciences at the University of Waterloo. Lingling has been an astrobiology post-doctoral fellow at the University of Wisconsin since graduating.

## 2011 Graduation

After NU's 153rd Commencement last June, which featured comedian Stephen Colbert, we held our own light-hearted reception honoring our graduates and their families. We celebrated the achievements of three EPS undergraduate majors, **Kristen Bartucci**, **Alexa Socianu** and **Joseph Walkowicz**; and two Doctors of Philosophy, **Derek Adams** and **Richard Barclay**. A few months later, **Simon Lloyd** received his Ph.D. We are proud of the close ties we build with our students and hope the relationships continue to grow!



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