

# epicenters

The Newsletter of the Department of Earth and Planetary Sciences at Northwestern University | 2013

JUDD A. AND MARJORIE WEINBERG COLLEGE OF ARTS AND SCIENCES

## Carrying the Torch: OAE Research a Tribute to Seymour Schlanger's Legacy

Ocean anoxic events (OAE's) were first defined by a former faculty member of our department, Dr. Seymour Schlanger, and his British colleague, Dr. Hugh Jenkyns (Schlanger and Jenkyns, 1976). The concept was based on widespread occurrence of relatively narrow intervals of organic carbon-enriched facies observed throughout deep sea cores, as well as in coeval epicontinental successions. Interest in such deposits was keen from the start due to their source rock potential. But when it was recognized that these intervals show significant excursions in stable carbon isotope values, indicating they represent major perturbations of the ancient global carbon cycle, it was apparent that OAE's provide an important record of ocean and climate system behavior that was forced beyond normal background conditions. Recent studies have suggested that these events were likely forced by massive submarine volcanic eruptions, which led to increased CO<sub>2</sub> levels and transient global warming. Professor Schlanger probably didn't realize that the phenomena he discovered could inform our understanding of the impact of human activity on the climate system, but that is exactly how we view OAE's today.

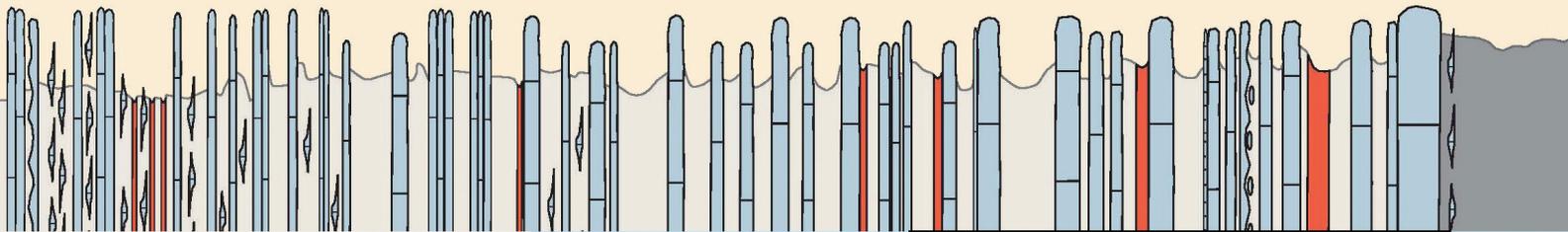
It is a tribute to the memory of Professor Schlanger that the department continues to pursue a vigorous research program on OAE's that involves undergraduates, graduate students, and faculty members. Professor Sageman has worked on Mesozoic and Paleo-

zoic OAE's for many years. His work has focused on refinement of high-resolution time scales for these events and their use for calculation of accumulation rates for key geochemical proxies that reflect changes in primary production, detrital dilution, and redox conditions in the water column and sediments (such calculations help in evaluating key environmental processes, such as changes in nutrient fluxes). An NSF-funded collaboration between Sageman and colleagues at the University of Wisconsin-Madison (including his former PhD. student Professor Steve Meyers, and Professor Brad Singer, dept. chair) culminated in a 2012 *Geology* paper that integrates new Ar-Ar and U-Pb ages with astrochronology to produce the highest-resolution time scale yet published for the Cenomanian-Turonian OAE2 interval. This project also led to the development of an educational exhibit on geologic time for the Lake Pueblo State Park, where the Cenomanian-Turonian GSSP (Global Section, Stratotype and Point) is located,



Seymour Schlanger

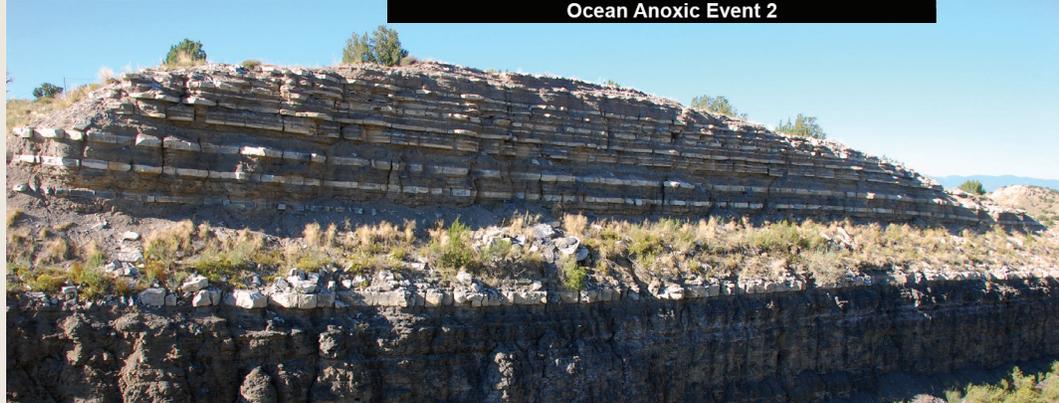
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Ocean Anoxic Event 2

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*Dark colored, organic carbon enriched shales, like those deposited during OAE's in many sites, are important source rocks for both conventional and unconventional energy resources. In the Rock Canyon Anticline section, near Pueblo, CO (above) the OAE2 interval actually occurs within the lighter-colored carbonate-rich facies of the Bridge Creek Limestone at the top of the section. A few 100 yards east of this location is the site of the Cenomanian-Turonian GSSP (see article above).*

## Message From the Chair



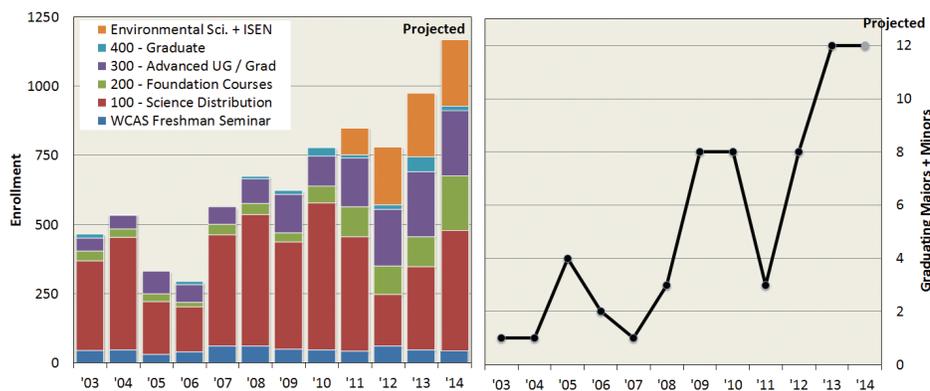
Greetings to Alumni and Friends,

It has been about a year since we moved the Department of Earth & Planetary Sciences into our new space in the F wing of the Tech Institute. Although we are still adjusting, the change has been positive overall. We are closer to the Hogan labs and our level of interaction with colleagues in engineering, physics, and chemistry has increased. Our new space has numerous amenities and is home to a growing and thriving

department. As you will read in the articles herein, our class enrollments and undergrad major are continuing to expand (see graph below), we have made exciting new faculty appointments (see article on Maggie Osburn next page), we are promoting existing members of our faculty, and our research productivity is excellent (check out the faculty highlights). We are extremely proud of our graduates at both the undergrad and graduate level as they move on to excellent opportunities beyond Northwestern, and we are equally excited about our new recruits to the program. Your donations have provided support for many aspects of the student experience in our department and this

support has been vital. Similarly, although the department faces a bit of a financial challenge this year, as we accommodate our portion of start-up costs for new faculty, your contributions have helped to buffer this impact. It is impossible to express fully how much we appreciate your support of the department. I hope you enjoy catching up on departmental activities in this year's newsletter.

Wishing you all the best,



## Scenes from the 2013 Graduation Reception



*Professor Sageman presented Maya Gomes with the Scott Award for Outstanding Graduate Research.*



The past year saw major changes in Northwestern's effort in sustainability and energy, which deeply involves department faculty. With the appointment of chemistry professor Michael Wasilewski as Executive Director, the Initiative for Sustainability and Energy at Northwestern (ISEN) was transformed into a research institute. In association with this change, Professor Brad Sageman was promoted from Associate Director of Education and Special Projects for ISEN to a position as Co-Director of the Institute. Brad will continue to manage the ISEN education portfolio and new certificate program, but his responsibilities within the organization have expanded. The Department of Earth and Planetary Sciences has deep investment in research and teaching related to energy and sustainability issues and department faculty continue to make important contributions to the institute.



*Students Brian Lach and Peter Ilhardt, along with Professor Steve Jacobsen, (center) delighted class of 2013 Reception guests with a chamber music performance.*



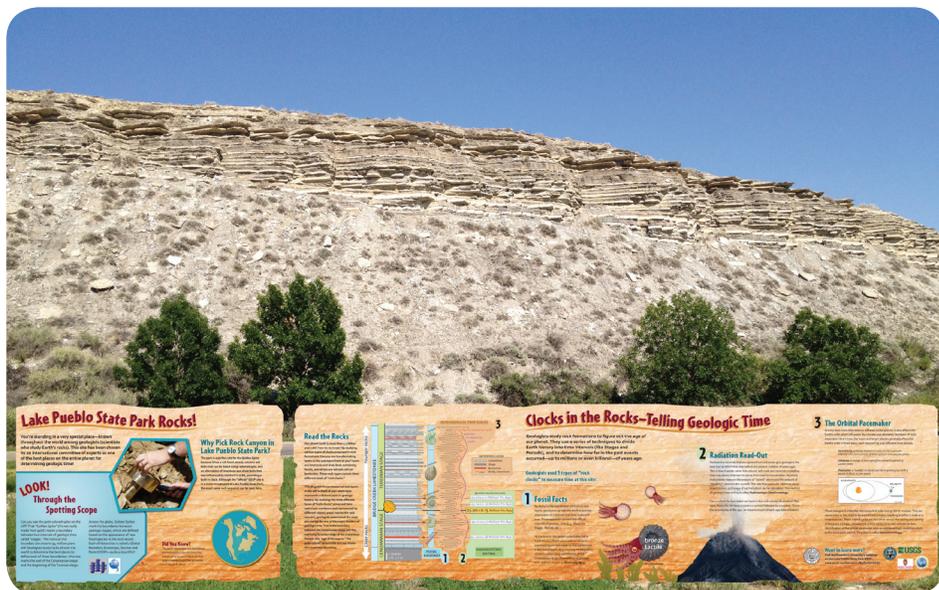
## Welcome Assistant Professor Magdalena Osburn!

**Magdalena Osburn** is an organic isotope biogeochemist. She is broadly trained in organic geochemistry, stable isotope geochemistry, microbiology, and stratigraphy and utilizes these skills in order to better understand modern biogeochemical cycling, the sedimentary rock record, and perturbations to the Earth system in the geologic past. Maggie will join our faculty in the fall 2014.

## Clocks in the Rocks

On October 25, 2013 an educational display, designed to teach the public about geologic time, was installed and dedicated at the Lake Pueblo State Park, near Pueblo CO. The sign (illustrated at the bottom of the photo) was designed by Professor Brad Sageman and his colleagues Professors Steve Meyers and Brad Singer from the University of Wisconsin-Madison, as well as the ECOS Communications Co. from Boulder CO. This display marks an extremely important geological feature that occurs within the section shown in the photo - it is the Global Section, Stratotype and Point (GSSP) for the Cenomanian-Turonian Stage boundary, an important

marker in the geologic time scale. This GSSP was defined by Dr's J. Kennedy, W. Cobban and I. Walaszczyk following years of work in the 1990's and earlier. The GSSP was ratified by the International Commission on Stratigraphy in 2002 and published in 2005 (Kennedy et al., 2005, *Episodes*). Development of the signage for the GSSP constituted the broader impacts effort of an NSF grant awarded to Singer, Meyers and Sageman in 2009. This project integrates new radioisotope dates with floating astrochronologies to yield the most highly resolved time scales for the Late Cretaceous that have yet been produced.



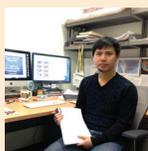
## EPS Welcomes and Good byes

**Welcome** to our new graduate students **Edward Brooks**, **Everett Lasher**, and **Jamie McFarlin**, and Postdoctoral Research Fellows **Dr. Hao Zhang** and **Dr. Xin Chen**. Welcome too, to IT Research Consultant **Dr. Baudilio Tejerina**, who joined our staff last spring, and Assistant Professor **Magdalena Osburn** (see above). Finally, congratulations to Research Associate and Stable Isotope Lab Manager, **Dr. Koushik Dutta**, and his wife, Soma, on the birth of

their twin babies Vishakha (girl) and Vibhan (boy) August 8, 2013.



**Goodbye** to PhD graduates **Dr. Young Ji Joo**, who joined the University of Oklahoma as a Postdoctoral Research Fellow last fall, and **Dr. Xiaoting Lou**,



now a geologist for Chevron. Goodbye also to Post doc **Dr. Min Sub Sim**, who joined CalTech to research sulfur isotopes in modern environments, and rock prep lab staff **Petra Sheaffova** and **Alexa Socianu**, who both left this year. A final farewell to the class of 2013! We honored students' accomplishments with a post-commencement reception in the spacious Tech atrium adjacent to our new home.

### Undergraduate Class of 2013

- Ellie Bensinger**
- Caroline Binkley\***
- Laura Beckerman\***
- Harry Hahn**
- Marial Henkoff**
- Peter Ilhardt\***
- Leah Isaman**
- Alex Kegley**
- Allegra Mayer\***
- Jennifer Mills**
- Andrea Salus**
- Matthew Sullivan**

\* Graduated with EPS honors

and the GSSP unveiling ceremony took place in association with this year's GSA meeting in Denver. Sageman has also been working with department colleague Professor Matt Hurtgen to combine Matt's expertise in sulfur isotope biogeochemistry with ongoing OAE2 studies. This resulted in a 2010 *Nature Geoscience* paper on OAE2 led by former graduate student Derek Adams (who now works for Exxon), as well as senior honors theses by undergraduate majors Allegra Mayer (now on a DAAD scholarship in Germany) and Laura Beckerman (now a graduate student at University of Colorado, Boulder). The OAE2 work also stimulated a new project on the Aptian OAE1a interval, which is being led by current graduate student Maya Gomes and undergraduate Jennifer Mills (who graduated this past June; she is currently a Marshall Scholar at Cambridge University in England). Jenny's efforts on the project led to the latest new contribution to our research team, from Professor Andrew Jacobson, whose expertise in Sr and Ca isotope analysis is provid-

ing new tools to help test our working hypotheses (both isotope systems are sensitive to the mass balance of fluxes from volcanic input vs. continental weathering). A final new chapter has opened on OAE2 with the funding of an Earth-Life Transition grant from NSF. Sageman and collaborators at MIT, U Mass-Amherst and Penn State will complete high-resolution core and outcrop work in Utah with the aim of reconstructing changes in food webs across the OAE interval. Part of Sageman's work on the project will involve collaboration with Professor Steve Jacobsen (Steve's Raman spectroscopy facility will be used to study changes in shell mineralogy to test for the effects of ocean acidification).

As this summary clearly shows, the diversity of people, skill sets, and tools being directed at OAE studies in the Department of Earth and Planetary Sciences is impressive. We suspect that Professor Schlanger would be excited and gratified to know that the work goes on.

## Learning Beyond the Classroom

“Where have you been lately?” is a question that is increasingly answered by our under-

graduates with stories of learning beyond the classroom. These experiences are commonly organized and driven by the students themselves, and they include locations throughout the United States, as well as many international destinations. Field works sites include the bogs and fens of Minnesota, the mountains and deserts of the western US, the archipelago of Svalbard, Norway, and even the Tibetan Plateau. These far-flung learning experi-



Zach Kisfalusi collects cores on the Fond Du Lac Reservation in Cloquet, MN, funded through an NSF REU

ences are rooted in the spirit of adventure, but they are also indispensable in helping to develop independent and advanced research skills. The growth in our pool of graduating EARTH majors, expanding from eight to twelve students over the last few years (see graph on page 2) has been matched by the diversity of off-campus learning experiences. The classic Study-Abroad semester remains a foundational experience for many, with four months of learning embedded at leading institutions abroad. But our students have found other options for off-campus learning as well. New Zealand is among the most competitive destinations due to its combination of excellent academic options, native language speakers, amazing geology, and breathtaking landscapes.

In general, our students have been very successful in their efforts to win support for off campus learning from the college, the University, and federal agencies. Both Northwestern's Provost Office and Weinberg College of Arts and Sciences award financial support for student-driven research projects. The Provost's office sponsors Undergraduate Research Grants (URG) over the academic year, as well as summer grants. Additional funds are possible through the College of Arts and Sciences.

Students may also apply



Kayleen McMonigal views the jungle from Cenote Pet Cemetery, Quintana Roo, MX. A WCAS research grant funded Kayleen's fieldwork.

to national competitions offered by federal agencies such as NSF and NOAA. The NSF funds Research Experiences for Undergraduates (REU) that involve thematic

research projects offered by small groups of faculty at institutions across the US. Each student is associated with a specific research project, where he/she works closely with the faculty and other

researchers. Students are granted stipends of \$3000-\$6000 for the summer and, in some cases, additional assistance may be avail-

able for housing and travel. Lastly, the department helps out with funds that are provided by alumni to support student research experiences. By leveraging funds from multiple sources we are able to extend the department's resources and still provide for some life-changing experiences. Our students deeply appreciate the opportunities that are provided with the help of support from our alumni.



Nora Richter's NSF research focused on studying the Holocene history of Lake Linne in Svalbard



World map with undergraduate research sites marked

## EPS Stable Isotope Lab

The Stable Isotope Laboratory of the Department of Earth and Planetary Sciences was established in 2008 by the Northwestern administration in order to support the biogeochemical research of four principal investigators, Profs. Neal Blair, Matthew

Hurtgen, Brad Sageman and former faculty member Francesca McInerney (who has moved to Australia; our new hire, Maggie Osburn will replace McInerney as the fourth member of the team), as well as other users within and outside the Northwestern community.



Initially set up in a temporary space while Hogan Hall renovations progressed, the lab moved to its present location (3-150 Hogan) in 2010 and has become an critical part of the Integrated Laboratories for Earth & Planetary Science. The lab is managed by Research Associate Dr. Koushik Dutta and is equipped with state-of-the-art equipment for analyses of light stable isotopes (C, N, O, S and H) in a wide variety of geological and environmental samples.

The facility is equipped with two Thermo Finnigan Delta V Plus stable isotope ratio mass-spectrometers (IRMS). Peripheral devices include a gas chromatograph (Thermo Trace GC Ultra) for compound specific carbon and hydrogen isotope analyses in organic compounds, a Thermo Gasbench II sampling device for isotopic analysis of carbonates, water and gaseous samples, a Costech ECS-4010 Elemental Analyzer (EA) for carbon, oxygen, nitrogen and sulfur isotopic analyses in solid samples, and a Thermo High Temperature Combustion/Elemental Analyzer (TC/EA) for oxygen isotopes in organic matter. Whereas rock and sediment samples are processed in our Rock Prep, Sedimentary Geochemistry and Organic Biogeochemistry laboratories, stable isotope analyses of processed samples

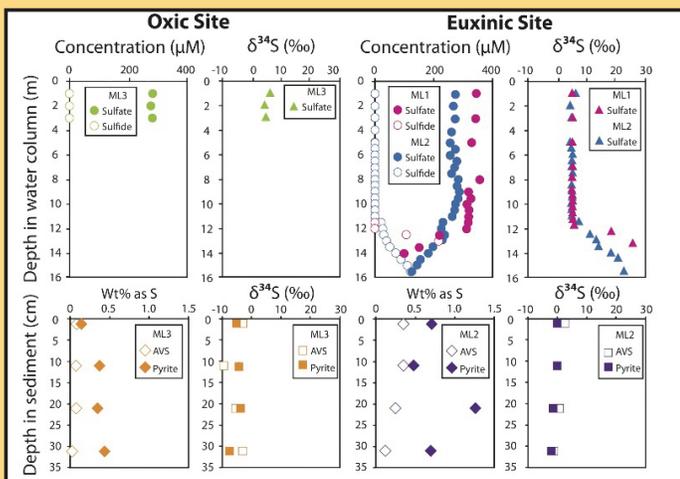
all take place in the IRMS lab.

This facility has provided stable isotope data for a wide range of research projects both within and outside the Northwestern research community. One key area of study in our department employs stable isotope data to reconstruct major perturbations in the biogeochemical cycles of carbon and sulfur that occurred in the deep past (e.g., see research highlights of Professors Hurtgen and Sageman and grad students Baczynski, Bush, Gomes, Gouldey, Jones, and Kristall). Such events record the full range of behavior of chemical cycles during ancient episodes of global climate change and provide important information for predictions of environmental change related to future global warming. Other projects focus on processes critical to the understanding of the global carbon cycle, such as the transport of carbon through various modern environments (e.g., see research highlights of Professor Blair and grad student Childress; Blair's research group has also successfully developed an ultrasensitive method for carbon isotopic analyses in volatile organic components from aqueous systems). In addition to these exciting projects, the lab supports ongoing work of former undergraduate and graduate students who continue to collaborate with department faculty and provides analyses for other users, including academic researchers as well as commercial entities.

## Stable Isotope Focus

Graduate student Maya Gomes, who was selected for a Northwestern Presidential Fellowship this year, and has been offered a post doctoral appointment at Harvard, has been applying stable isotope data to learn how the size of the sulfate reservoir affects the preservation of sulfur isotope signals in modern and ancient environments. Her work includes analyses from Lake McCarrons, a modern euxinic lake near St. Paul, Minnesota, as well as samples from Cretaceous OAE's. The depth profiles of sulfur isotopes

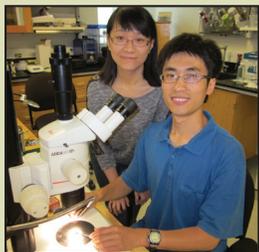
( $\delta^{34}\text{S}$ ) in sulfides and sulfates of the lake water column and ( $\delta^{34}\text{S}$ ) in acid volatile sulfur and pyrite from the lake sediment were analyzed. The results indicate smaller differences of ( $\delta^{34}\text{S}$ ) between sulfates and sulfides in the sediments ( $\delta^{34}\text{S} \sim 5$  to  $10\text{‰}$ ) despite relatively large isotopic fractionation ( $\sim 24\text{‰}$ ) associated with microbial sulfate reduction. The study has important implications for studies of sulfur biogeochemistry in modern and ancient environments. The results were published in the journal *Geology* (v. 41, p. 663-666, 2013).



Lake McCarrons, MN



## Beam on Postdoctoral Research



Postdoctoral researcher **Dr. Xiaobing Liu** (right) is working on the design, synthesis and characterization of superhard materials in Professor Steve Jacobsen's mineral physics laboratory. Single crystals of BCxN grown by Xiaobing may rival diamond in hardness, but have higher thermal stability, making it a potential superabrasive.

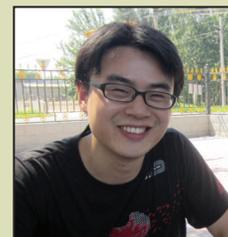
In late 2013, **Dr. Xin Chen** (above left), previously at Oakridge National Laboratory, joined the mineral physics group. Dr. Chen specializes in theoretical investigations of material properties at high pressures.



**Dr. Dorothée Husson** joined the department as a post-doctoral researcher in January 2013. She is working with Brad Sageman on carbon capture and sequestration, and development of a strategic plan for a Northwestern research center focused on carbon sci-

ence and management. Dr. Husson shares a common interest in cyclostratigraphy with Sageman, and they are working on some projects in this field as well. Lastly, Husson and Sageman are collaborating with John Lazarz, Steve Jacobsen, Andy Jacobson and Craig Bina on an experiment exploring the mineral physics underlying mineralization of CO<sub>2</sub> at high pressures.

Last October, we welcomed **Dr. Hao Zhang** to the Department as a postdoctoral researcher. Hao received his PhD at Peking University, China, where he used seismological approaches to retrieve the maximum damage regions immediately after a disastrous earthquake. Most recently he applied a back projection technique to infer the detailed rupture process of the May 24, 2013, M8.3 earthquake deep beneath the Sea of Okhotsk. He presented this work at the 2013 Fall AGU meeting. Dr. Hao Zhang and Professor Suzan van der Lee are currently investigating crustal discontinuities as well as the variable sources of ambient seismic noise.



## Remembering Robert Speed



**F**rom 1966 to 2002 Professor Robert C. (Bob) Speed served as a faculty member in the Department. He initiated the Integrated Science Program at Northwestern, a highly selective curriculum of natural sciences and mathematics taught at an accelerated pace, for which he served as first Director during 1975-1979. In 1991 he was named Charles Deering McCormick Professor, and during 1996-2000 he directed the Environmental Sciences Program. During his

career, Bob trained many students, and he contributed greatly to our understanding of the tectonics and structural geology of active continental margins, in particular through his detailed field studies of the western U.S. and the Caribbean. When Speed passed away in 2003 he left behind some significant geologic contributions concerning the island of Barbados that he had not had time to finalize for publication. These included a geologic map of the entire island, as well as Bob's notes on the interpretation of features he had observed over many years of field work. In addition to mapping marine terraces and landslide sheets, Bob's students may recall that his work in Barbados featured many adventures, including free-climbing 35-meter cliffs and leaping from a bridge into a hornet's nest to evade a reckless driver. Were it not for an extraordinary investment of time and funding by Professor Speed's wife, Christine (pictured above with faculty members Craig Bina [left] and Brad Sageman before a projection of the Barbados map), as well as the geological expertise and editorial devotion of Bob's former student,



*Craig Bina, Christine Speed, and Brad Sageman superimposed over Robert Speed's Barbados map*

Professor Richard Sedlock (San Jose State University), this work might have never been published. Instead, Christine is holding *Geological Society of America Special Paper 491* entitled "Geology and Geomorphology of Barbados" which she and Sedlock brought to fruition in 2013. Despite Bob's own assertion that describing the geology of an entire country was something that only 19th-century geological pioneers could presume to attempt, he seems to have accomplished something similar at the dawn of the 21st century.



## Faculty Highlights

**Yarrow Axford** and her students are keeping busy in the new Quaternary Sediment Lab, examining stratigraphic records of (geologically) recent climate change from the Andes to the Arctic. Charcoal and microfaunal analyses of sediment cores from high-elevation lakes in the Peruvian Andes are yielding insights about Holocene climate and vegetation change near the rapidly shrinking Quelccaya Ice Cap. Paleoecological analyses of cores from lakes around Greenland's margins are permitting rare quantitative reconstructions of Arctic temperatures during the early Holocene and possibly Last Interglacial warm periods. Field investigations are ongoing in northwest Greenland near Thule, and two new graduate students joined the Greenland research group this September. Welcome Jamie McFarlin and Everett Lasher!

**Patricia Beddows** continues to work on improving the form and function of our new space. She finds it heartwarming to see students and faculty settled in and working productively in the new offices and labs. In addition, as Director of the Environmental Field School, Patricia oversees the placement of students during the summer in National Parks/Forests from Alaska to Utah, and California to Kentucky. An ISEN Booster Grant now supports her project "Discharge of sequestered P and Fe with impact on coastal carbonate factories." Undergraduate Peter Ilhardt completed his senior thesis under Trish's direction, winning a poster award for his research "Investigation of potential microbialite formations in the cenotes of the Yucatán Peninsula."

**Craig Bina** returned briefly to Charles University in Prague (Czech Republic) in February, to continue work on subduction dynamics with colleagues there, some of which was accepted for publication in August. He also visited Ehime University in Matsuyama (Japan) in March, where he was an invited speaker on lunar stress fields at the 3rd Global-COE International Symposium. There he and several international colleagues were honored in a special ceremony by the president of Ehime University for their contributions to worldwide research collaboration. In May he joined Steve Jacobsen in co-leading a petrology field trip to Michigan's Upper Peninsula, and in June he and Professor Jacobsen attended the COMPRES meeting in Lake Geneva, Wisconsin. Professor Bina completed his year-long term as Interim Department Chair at the end of August. In September he attended the 13th International Workshop on Modelling of Mantle and Lithosphere Dynamics in Hønefoss (Norway), where he chaired a session and presented work on mineral metastability in subduction zones.

**Neal Blair's** research has focused on multiple aspects of the C-cycle. A NSF GeoPrisms project focuses on the transport of recycled organic C across active margins. PhD student Laurel Childress is working on this project. The role of soil fungi in the sequestration of organic C is being explored with collaborator Louise Egerton-Warburton of the Chicago Botanical Garden and post-doctoral fellow Katie Schreiner. This project is supported by ACS-PRF. David Vinson is a NSF post-doctoral fellow in the group and he is investigating pathways of biogenic methane formation in coalbeds.

**Matt Hurtgen's** research group utilizes geochemical signatures preserved in sedimentary rocks to reconstruct the chemistry of ancient oceans. In June 2013, PhD student Maya Gomes published her sulfur isotope work from Lake McCarrons, MN in *Geology* (see pages 5,10). Graduate students Jeremy Gouldley and Brian Kristall continued their work reconstructing the sulfur isotope evolution of the Neoproterozoic and Cretaceous oceans, respectively, while postdoctoral fellow Min Sub Sim worked to better understand Late Devonian perturbations to the carbon cycle (Frasnian-Famennian and Punctata events). Furthermore, undergraduates Laura Beckerman, Caroline Binkley and Jennifer Mills all completed senior theses.

**Steve Jacobsen's** mineral physics group studies the chemical and physical properties of Earth and planetary materials as they apply to geophysical processes and materials science. In 2013, Jacobsen received the Weinberg College Distinguished Teach-

*Continued on page 8*



*Patricia Beddows (right) and Emiliano Monroy-Ríos collect rock samples during a cave dive in the Yucatán Peninsula*



*Craig Bina (standing-left) was honored in a special Ceremony last March at Ehime University, in Matsuyama, Japan*



*Steve Jacobsen (left) demonstrates a hydrogen fuel cell in his freshman seminar on energy*



*Emile Okal and Trish Beedows collect tsunami data in Honduras*



*Asia, Brad, & Monica Sageman with graduate student Brian Kristall during our New Year - New Space Celebration*



*Seth Stein stands beside the Primate Center sign, one of many science buildings in Göttingen, Germany*

*Faculty Highlights continued from page 7*

ing Award and gave a number of invited research talks, including at Cornell, Brown, the University of Colorado, Northwestern's Physics and Astronomy department, the Advanced Photon Source, and at the Gordon Research Conference on Earth's interior. Jacobsen serves on the Administrative Board of The Graduate School and is Associate Editor of *Geophysical Research Letters*.

**Andrew Jacobson** directs the Environmental Sciences Program and remains Director of Undergraduate Studies for EPS. Jacobson recently received two NSF grants, one examining carbon cycling at the margin of the Greenland Ice Sheet and the other using radiogenic isotopes to trace water mass mixing in the Canadian Archipelago. PhD student Greg Lehn continues to investigate climate change in northern Alaska and is pioneering methods for measuring Ca isotopes by MC-TIMS. PhD student Grace Andrews is studying chemical weathering in Fiordland, New Zealand and will take the lead on Jacobson's new Greenland project. Dr. Alain Potrel continues to manage Jacobson's Radiogenic Isotope Facility.

**Donna Jurdy** taught "Exploration of the Solar System" again at the University of the Chinese Academy of Sciences in Beijing, invited by former student Han Li. Currently on the Board of the Association for Women Geoscientists, she chairs their award committee, and also serves with NSF to evaluate graduate fellowships. Donna works on planetary surfaces to understand their tectonics and evolution. She studies craters on Titan with graduate student Ashley Gilliam to peer below its surface, and the magnetization of Mars with graduate student Renee French.

Emeritus professor **Abraham Lerman** continues to work on the global biogeochemical cycles of carbon, nitrogen, phosphorus, and silica, with graduate students Darcy Li and Young Ji Joo (who defended her PhD dissertation in July 2013), and he began in 2012 a study, with graduate student Ashley Gilliam, of the evolution of the atmosphere of Saturn's biggest satellite Titan.

**Emile Okal** continued his work on historical earthquakes and tsunamis. This year, he conducted field work in Honduras and Haiti to reconstruct 19th century tsunamis in the Caribbean. He was invited to give lectures in Austria, Haiti and Turkey.

**Brad Sageman** had a productive sabbatical year in 2012-13, working on eight new co-authored publications (all of which are accepted with minor revisions), and four grant proposals (three of which were funded). His most recent PhD graduate, Dr. Young Ji Joo, successfully defended her thesis in August and moved to a post doctoral appointment. Brad has one new PhD student, Matt Jones, and has been working with post doctoral scholar Dorothee Husson (funded with support from NSF-SEES program, as well as ISEN). Her main focus has been carbon capture and storage, including new experimental work in collaboration with Professors Jacobsen and Bina and graduate student John Lazarz. Brad is also collaborating with Professor van der Lee and PhD student Trevor Bollmann on evaluation of models for the origin of the Western Interior foreland basin, and with Professors Hurtgen and Jacobson in ongoing studies of ocean anoxic events (see cover story). Last but not least, Brad was appointed as co-chair of the Northwestern Sustainability Council, and co-director of the Institute for Sustainability and Energy at Northwestern.

The Alexander von Humboldt Foundation has awarded **Seth Stein** a Humboldt Research Award. Humboldt awards promote academic cooperation between scientists and scholars from Germany and abroad. This award is granted "in recognition of a researcher's entire achievements to date to academics whose fundamental discoveries, new theories, or insights have had a significant impact on their own discipline and who are expected to continue producing cutting-edge achievements in the future."

Award winners are invited to spend a period of up to one year cooperating on a long-term research project with colleagues in Germany. Seth and his wife Carol have

settled in to the rhythms of life in Göttingen, Germany, collaborating with Dr. David Hindle and Professor Jonas Kley on problems in interplate and intraplate tectonics.

**Suzan van der Lee** is ramping up for teaching her tenth new course in her ten years at Northwestern. She is continuing her research on the deep structure and dynamics of the Americas and the Tethys Belt, with a particular emphasis on the Mid-continent Rift System and East Asia, the latter spearheaded by graduate student Michael Witek. The SPREExperiment was dismantled in October and analyses of the complete data set by graduate students Emily Wolin and Trevor Bollmann are in full swing. Van der Lee also re-installed an adapted version of the Locy Hall Seismology kiosk, adopted USArray station L44A at Ryerson Woods for Northwestern, and again organized and hosted two instances of the popular "USArray Data Processing for the Next Generation of Seismologists" short course during the summer.



*Suzan van der Lee with graduate student Emily Wolin, alum Simon Lloyd, and Financial Assistant Ben Rice pause before dismantling SPREE equipment in WI.*

## Graduate Student News

This has been a terrific year for our graduate program. We welcomed three new graduate students in fall of 2013. Eddie Brooks joined Professor Seth Stein's group, and Everett Lasher and Jamie McFarlin will study with Professor Yarrow Axford. We look forward to watching their academic careers unfold!

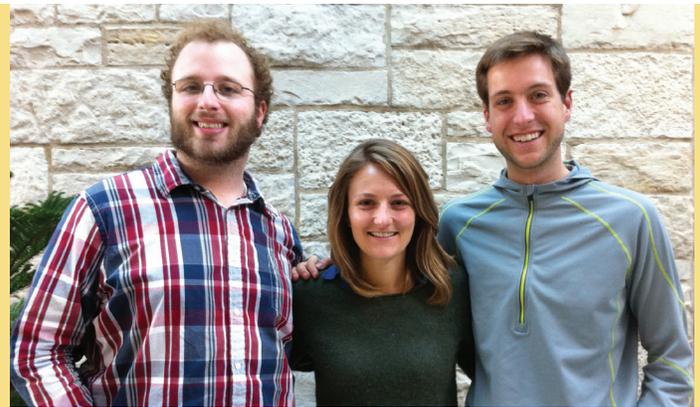
It has been a year for awards and publishing as well! Many students have published in journals like *Nature Geoscience*, *Geochimica et Cosmochimica Acta*, *Geology*, and more. Others have won awards through NASA, the Schlanger Ocean Drilling program, or Northwestern's own Presidential Fellowship. Please read each students' entry below for information on awards, publications and student research.

**Grace Andrews** has spent the last few months working to complete the radiogenic Sr analysis of river, bedrock, sediment, soil, and plant samples from her study of chemical weathering rates in Fiordland, New Zealand. She has also worked, alongside her lab group, to develop an improved method for the measurement of stable Sr isotopes, which she will measure on the Fiordland samples as well.

During the past year **Allie Baczynski** presented her research at three conferences and spoke at a symposium in Worland, Wyoming. This summer she participated in a workshop in Boulder, Colorado, where she learned about preparing for an academic career in the geosciences, and the journal *Geochemistry, Geophysics, Geosystems* published her manuscript on PETM chemostratigraphy in the southeastern Bighorn Basin, Wyoming.

**Trevor Bollmann** is continuing work on his tomographic model of the Mid-Continent Rift using teleseismic P and S-waves. Over the summer, Trevor was a Professional Intern at Chevron in Midland Texas working on Asset Development in the Permian Basin. In October, Trevor along with other grad students successfully removed the SPREE seismic stations in Northern Ontario.

**Rosemary Bush** has been continuing her investigations of plant n-alkane biomarkers as paleoenvironmental proxies, and



*Our new PhD students Eddie Brooks, Jamie McFarlin & Everett Lasher*

one of her studies was recently published in *Geochimica et Cosmochimica Acta*. Her work tests whether n-alkane molecular distributions are driven more by plant type or by climate, and she is also studying biomarkers and stable isotopes from fossils and ancient sediments. This summer she attended a workshop on preparing for a geoscience academic career in Boulder, CO.

**Yun Yuan Chang** published two papers and also co-authored two papers in 2013. She was invited to give a talk in the annual review section of HPCAT, Argonne National Lab in March 2013. Currently, she is working on the elastic properties of superhard material and her PhD dissertation.

**Laurel Childress** was funded this year by a Schlanger Ocean Drilling Fellowship, to investigate carbon/tectonic interactions in Cascadia. Most recently she spent two months sailing in the Gulf of Alaska on IODP Expedition 341, investigating carbon transport in past glacial/interglacial sequences. She also attended the NSF GeoPRISMS NZ Primary Sites workshop in Wellington, NZ in April 2013, and was awarded Best Oral Presentation of a Student Poster.

**Renee French** spent the summer at NASA's Marshall Space Flight Center in Huntsville, Alabama, testing the accuracy and precision of an in situ geochronology experiment for a planetary rover. While at Northwestern, she utilizes Lunar Reconnaissance Orbiter Camera (LROC) images to characterize recent activity of young tectonic features on the Moon.

## Graduate Student Service & Outreach



*Darcy Li shares her knowledge about rocks with Project Excite! students*



*EPSers have participated in sustain NU Game Day Challenge for 4 years now, and are the largest volunteer contingent*



*Two Project Excite! students learn about Earth with Trevor Bollmann*

*Graduate Student News continued from page 9*

**Ashley Gilliam** was awarded the NASA Earth and Space Science Fellowship to support her work with Professor Donna Jurdy on Titan's impact craters and associated fluvial features as evidence for a subsurface ocean. Ashley has also been working with Professor Emeritus Abraham Lerman modeling the evolution of the major gases in Titan's atmosphere and cooling since accretion. She has submitted her second paper for publication.

**Maya Gomes** published a paper on sulfur isotope systematics in low sulfate systems in the journal *Geology* (co-authored with advisor Matthew Hurtgen), was awarded The Graduate School's Presidential Fellowship, and attended two professional meetings where she presented work on sulfur cycling during Cretaceous Ocean Anoxic Events and sulfur isotope preservation with implications for paleoenvironmental reconstructions.

**Jeremy Gouldley** received a GSA student research grant to continue his work on sulfur and carbon cycling during the Cryogenian. During the summer, he taught a graduate course on ancient climates he developed for the SESP dept, and taught workshops to incoming NU graduate TAs at the New TA Conference. Jeremy also served as part-time faculty for the Department of Environmental Science at Loyola University during their fall semester, teaching a course in weather and climate.

**Matt Jones** is analyzing the geochemistry of a low-latitude Late Cretaceous sedimentary sequence cored by the Ocean Drilling Program. The goal is to develop a better understanding of changes in the ocean in the Turonian Stage following a major ocean anoxic event, and to enhance the precision of the Geologic Time Scale.

**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.

**John Lazarz** studies materials under extreme conditions. Through the use of diamond-anvil cells, he examines novel structures of minerals under conditions similar to those in the deep Earth. Using x-ray diffraction and Raman spectroscopy John studies both the structure of cement degrading minerals, recently presented as a poster at the 2013 COMPRES annual meeting, and possible reactions occurring during CO<sub>2</sub> sequestration.

**Greg Lehn** is investigating the impact of seasonal permafrost thaw on calcium and strontium isotope signals in rivers on the North Slope of Alaska. His first paper was published in the *International Journal of Mass Spectrometry*, detailing an optimized method for analyzing calcium isotopes. Greg is applying the same techniques to the strontium isotope measurements, improving its sensitivity as a geochemical tracer.

**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 paleo-productivity changes since the Last Glacial Maximum.

## Graduate Student Field Research & Trips

**Miguel Merino** published his work on The Mid-Continent Rift in *Geophysical Research Letters*. This paper was highlighted in the journal *Nature Geoscience*. This summer Miguel worked for Chevron on unconventional shale reservoir characterization. Miguel plans on continuing his research on intraplate earthquake recurrence this year, and he also plans on defending his thesis winter of 2014.

**Emiliano Monroy-Ríos** has been investigating the desorption and preferential dissolution of the key elements P and Fe from the fresh-saline stratified coastal aquifer of the Yucatan Peninsula, which is a geologically stable carbonate platform. The lack of detailed geological mapping in this region is proving to be a significant impediment to the process based hydrogeochemical understanding. Recently, he started to develop the necessary geological framework by analyzing remote sensing LiDar datasets, attending a specialized course at the San Diego Supercomputer Center in UCSD, allowing him to handle and manage large remote sensing datasets and their integration with other geospatial data.

**Shuoxian Ning** works on ambient noise analysis, aiming at providing a tomographic model for East Asia with a higher resolution in crust and upper mantle. In order to get high quality cross-correlations and thus better resolved dispersion curves, Shuoxian preselected the datasets and analyzed the instrumental responses for every station.

**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.

**Amir Salaree** is interested in mechanism and modeling of tsunamis. Currently he is studying the 1990 Caspian Sea tsunami which was triggered by the 1990 Rudbar earthquake. He is also interested in intermediate to deep focus earthquake mechanisms, and different methods of addressing such events.

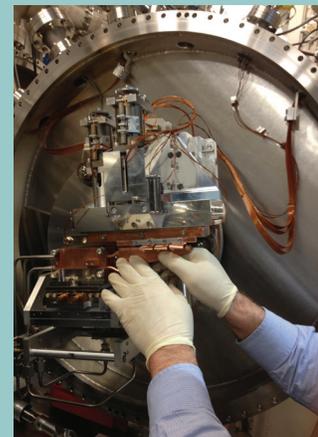
**Joshua Townsend** published a paper in *Physics and Chemistry of Minerals* on the equation of state and phase diagram of BaCO<sub>3</sub> last March. In May, together with a scientist at Brookhaven National Lab, he finished construction and calibration of a new laser-heating system for high pressure diamond anvil cell experiments. Currently, he is finishing some computer simulations of hydrogen in high-pressure silicates.

In September **Michael Witek** traveled back to South Korea to meet with Professor Tae-Seob Kang at Pukyong National University to work on a manuscript that will be submitted for publication before the end of the year. He has been working on determining the S-velocity structure of East Asia using ambient noise data from Korean and Japanese networks. In October, with the SPREE experiment coming to a close, he traveled to Canada to help take out SPREE stations.

**Emily Wolin** continues to investigate the structure of stable North American lithosphere. In July, she spent a month in Berkeley, CA participating in the CIDER summer program on continental formation and evolution. October marked the end of the 2.5-year-long Superior Province Rifting Earthscope Experiment (SPREE), and Emily led a team that uninstalled approximately 20 stations in northern Wisconsin and Minnesota. She presented results from analysis of SPREE and Transportable Array data at AGU's Fall Meeting in December.



*Grace Andrews, Matt Jones and Professor Steve Jacobsen on the Petrology Field Trip in the Upper Peninsula, MI*



*Students in the Jacobsen group conducted several experiments at Argonne National Lab this past year*



*Emily Wolin needed cross-country skis to service SPREE equipment in WI last April*

## Alumni News



**Derek and Kim Adams (PhD 2011 and MS 2009)** respectively) are new parents of a baby boy! Clark arrived March 22 at 12:34 PM. He weighed 8lbs 13.6 oz and was 20.5 inches long...  
**Caroline Binkley**

**(BA 2013)** "I am having a great start at UT. It looks like I will be using biomarkers and stable isotopes to reconstruct mega droughts with possible (think) applications to proximal volcanics. Anyway, I am very excited!"...Congratulations to **Clayton Brengman (BA 2012)**, and sister **Latisha Brengman (BA 2009)** for winning 2014 GSA Graduate Research Awards...**Sung-Joon Chang (Post doc 2010)**, who worked with Professor van der Lee, is now an Assistant Professor in the Dept. of Geophysics at Kangwon National University...**Howard Cramer (PhD 1954)** "Finally have had to stop travelling--not all my old memory so don't dare leave home. Having a blast otherwise."...**Kathleen F. Perry Davis (MS 1969)** Retired, US Navy, senior chief petty officer, 2002; Retired, US Navy, nuclear engineer, 2004. Self-employed, translation of technical and scientific documents with specialties in patents and geology; Slavic, French, and Germanic languages. Currently at summer house in Bremerton WA, doing repairs...  
**Jim Dorman (MS 1951)** "Now enjoying retirement in Memphis [from U of Memphis Earthquake Center] I have joined the Engineers Club of Memphis in order to attend its interesting technical programs. And for next week I have arranged for Club members to tour the

Nucor Steel recycling plant here in Memphis. Nucor will open its first primary iron production facility in Louisiana this fall - direct reduction of hematite pellets using natural gas. I often think of the Northwestern Lake Superior field trip of 1949 with Profs. Art Howland and John Stark when we saw the mining operations in the giant hematite pit at Hibbing, Minnesota"...**Harry Hahn (BA 2013)** Is in Austin, TX now--working for the San Francisco Consulting Group and training to become a skilled cloud ninja over the next 7 months. "I've made a few friends, some working geologists. Last weekend I was with [Alum] Carra Binkley...We went to the farmers market."...**Amy Hull (PhD 1987)** "I am senior materials engineer in Corrosion & Metallurgy Branch in Division of Engineering, Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission. Focus on dissolution of metals, a step away from dissolution kinetics of minerals"...**Pamela Jansma (PhD 1988)** is a 2013-2014 ACE Fellow at Colorado State University, working with the Provost and President, while maintaining her responsibilities as the Dean of the College of Science at University of Texas at Arlington...**Jonathan Lincoln (PhD 1990)** "Although I am spending too much time on administrative work these days (Vice Provost and Dean for College of Science and Technology), I did just get back from Cameroon where I have recently joined a project examining climate change impact in the country:"...  
**Glen Mattioli (PhD 1987)** "I am in my second year on assignment at UNAVCO as the Director of Geodetic Infrastructure. In this role, I am the director of the Plate Boundary Observatory and COCONet." ...**L. Niel Plummer (PhD 1972)** "After 39 years with the US Geological Survey, Reston, Virginia, I retired on January 3,

2012. In retirement I have continued with some on-going research projects and, now, freed of administrative duties and supervisory responsibilities, I have had time to finish a number of research papers. Phyllis and I live in Gainesville, VA in a place called Heritage Hunt. We have 4 children all grown and married living in the Washington D.C. area, and nine grandchildren. We are in the process of building a small house on water in the Northern Neck of Virginia, near Chesapeake Bay and the Potomac River. This will be a nice weekend get-away place for the family. I don't know how much longer I will stick with the science, but for now, I am enjoying it."...After spending the previous seven years as a submarine officer in U.S. Navy,  
**Brandon Ray (BA 2005)** has started a MS/PhD program in Atmospheric Science at University of Washington. His research will be focused on role of sea ice-albedo feedback in sea ice predictions...**Kimberly Schramm (PhD 2007)** "In January, I returned to work as a contractor in the Geophysics and Atmospheric Science Dept. at Sandia National Labs. It has been so much fun to work again. My two girls, Madelyn and Daria love going to preschool and are learning so much!"...**Alexa Socianu (BA 2011)** "I started graduate school at the University of Wyoming this past summer. My work is focused on fluid-rock-CO<sub>2</sub> interactions in the shallow crust with my advisor, John Kaszuba." ...Congratulations to **Joseph Walkowicz (BA 2011)** for winning a 2014 GSA Graduate Research Award.



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