

GEOSCIENCE NEWS

For Alumni and Friends of the Department of Earth & Environmental Sciences





Dear Alumni and Friends,

It is with pleasure that I once again send greetings as we begin our second year as the Department of Earth and Environmental Sciences. We had an eventful year, and the most exciting news to report is our new faculty hire of Adam Simon in the area of *Mineral Resources*.

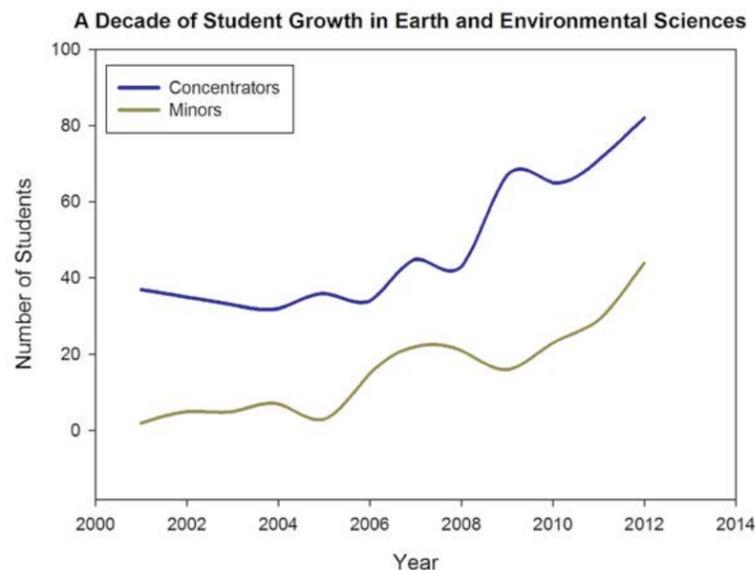
As I outlined in my letter last year, the Department undertook a faculty search last winter in the two broad areas of *Energy/Mineral Resources* and *Global Climate Change/Water Sustainability*. We are delighted to have successfully recruited Associate Professor Adam Simon (see profile on p. 9), who received his Ph.D. from the University of Maryland in 2003. After a postdoctoral appointment at Johns Hopkins University, Adam became a faculty member at the University of Nevada, Las Vegas from 2005–2012, where he developed an active research program with several graduate students, earned a College-

wide teaching award, and forged relationships with various mining companies in the western United States. Thus, Adam is well positioned to continue the rich tradition of excellence in Economic Geology practiced by our Emeritus Faculty, Bill Kelly and Steve Kesler (Professors in our Department from 1956 to 1994 and 1977 to 2011, respectively).

This upcoming year, we will undertake another faculty search, this time inviting applications from three broad areas: (1) *Global Climate Change/Water Sustainability*, (2) *Geochronology*, and (3) *Aqueous Geochemistry/Low-Temperature Geochemistry*. These areas of faculty expertise were identified in our 2011 Long-Term Strategic Plan, and it will be exciting to see how this search unfolds.

Given our continued departmental interest in *Energy Resources*, we are delighted to sponsor the screening of SWITCH, a documentary developed by Professor Scott Tinker (MS '85) with filmmaker Harry Lynch, that educates a broad audience on all the available sources of energy, including traditional, alternative and renewable, with an objective assessment of costs, efficiencies, and the societal challenge of making the "switch" to newer sources. The film will be shown on Thursday, Oct. 18th at 7 p.m. at the Power Center on the University of Michigan campus, followed by a Question & Answer session with Scott Tinker and other energy specialists across the campus, including the Director of the Energy Institute at the University of Michigan. Various U-M student organizations will be participating as well including the Michigan Energy Club.

Other developments in the Department include yet another banner year for graduate student recruitment. This fall, we welcomed 24 new graduate students, the largest incoming class in over a decade. We continue to see strong growth in our undergraduate program, and ended the 2011–2012 year with 82 majors and 44 minors (see graph). Part of the rich learning experience we are able to offer these students includes international field trips, such as the one led by Professor Kacey Lohmann this summer to Spain (see profile on p. 16). In addition, this past summer



Camp Davis saw the highest enrollment in its history, with 120 students enrolled in six different courses offered by our Department. Last, but not least, we are deeply grateful for the continued generosity of you, our alumni. Your gifts to the Department *make all the difference!* Your generosity is critical in allowing us to offer all our students the very best possible educational and research experiences. We are especially pleased to announce two bequests that we received this year: (1) \$100,000 from the estate of Claire C. Carlson to establish a scholarship for undergraduate students in the name of her husband, William S. Carlson (BS '29), and (2) \$100,000 from the estate of Violeta Peña y Lillo to establish a scholarship to assist female graduate students.

In closing, I wish you a happy and healthy holiday season, and always look forward to hearing from you!

Becky Lange
Chair, Earth and Environmental Sciences

Cover Photograph:
Students exploring Cretaceous marine strata in Basque Country during the 2012 international geologic field trip to Spain. See page 16 for additional photos from this trip.
(Photo: Petr Yakovlev)



Left:
Copper specimen from the Department's mineral collection. The specimen is from Michigan's Upper Peninsula and was included in a showcase that won a Best Museum Exhibit Award at the Denver Gem and Mineral Show. See page 5 for additional information.
(Photo: Chris Stefano)

Geoscience News is compiled periodically for alumni and friends of the Department of Earth and Environmental Sciences at the University of Michigan, Ann Arbor, MI 48109-1005

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Honors and Awards

Departmental Graduate Awards 2012



Rackham Dissertation Award

Daniel Horton (PhD 2011) received a Rackham Dissertation Award for his dissertation on *Climate Dynamics of the Late Paleozoic Ice Age*, advised by Chris Poulsen. The Rackham Dissertation Award is granted to only a handful of graduate students across the University each year. Dan is currently a postdoctoral fellow in the School of Earth Sciences at Stanford University.



John Dorr Graduate Academic Achievement Award

Alison Duvall (PhD 2011) received the Department's Dorr Graduate Award for her dissertation on *The Tectonic Evolution of the Tibetan Plateau: Insights from the Deformation and Erosion History of Northern Tibet and the Surrounding Region*. Alison was advised by Marin Clark. Alison spent a year as a CIRES Postdoctoral Fellow at the University of Colorado, and accepted a position as an Assistant Professor at the University of Washington this fall.



Outstanding Graduate Student Instructor Award

Laura Waters (PhD candidate) was recognized by the Department for her contributions to undergraduate education as a graduate student instructor. Laura has served as a graduate student instructor of EARTH 116 (Introductory Geology in the Rocky Mountains) and EARTH 341 (Ecosystem Science in the Rockies) at Camp Davis, and EARTH 120 (Geology of the National Parks) and EARTH 310 (Geochemical Evolution of the Solid Earth: Magmatism and Metamorphism).

GeoClub and SGE Awards

GeoClub continues its tradition of honoring students and faculty through teaching awards, and to undergraduates to help defray the costs of textbooks and field equipment. Five recipients this year received awards from GeoClub.

Book Awards

Chris Whalen (BS '13)

Field Gear Awards

Peter Chutcharavan (BS '13)

Tess Nugent (BS '13)



Sandra Fernando
GeoClub Best GSI Award

Sandra Fernando (PhD candidate) was selected by GeoClub as an outstanding GSI for her instruction in Mineralogy.

In addition, **Rod Ewing (Professor)** was selected as the GeoClub Outstanding Professor recipient.

Department's honor society, Sigma Gamma Epsilon, a chapter of the National Earth Science Honor Society, selected **Marissa Gunnarson (BS '12)** as recipient of the SGE Iota Chapter W. A. Tarr Award for outstanding achievement and service.

Departmental Undergraduate Awards 2012

The Department recognizes its undergraduates with four awards each year. The Academic Excellence Award recognizes a senior for academic achievement. The Camp Davis Field Geologist Award is given to the student with the strongest performance in the EARTH 440 Geology Field Course. The Singer Award for Academic Excellence in Geology is awarded annually to a student of junior standing who has demonstrated the highest level of academic achievement in their class. The Alumni Undergraduate Award is given to a student who has made outstanding contributions to the Department through spirit and service.



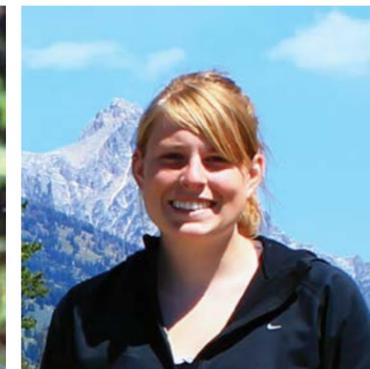
Keegan Melstrom (BS '12)
Academic Excellence Award



Marissa Gunnarson (BS '12)
Alumni Undergraduate Award



Sul Gi Ye Park (BS '12)
Academic Excellence Award



Megan Mueller (BS '13)
Eugene and Elizabeth Singer Award for Academic Excellence in Geology



Zachary Calamari (BS '12)
Camp Davis Field Geologist Award



Grants and Honors

Three U-M graduate students received GSA Graduate Research Grants, including **Sarah Aarons (PhD candidate)**, **Lydia Staisch (PhD candidate)**, and **Petr Yakovlev (PhD candidate)**. In addition, **Ethan Hyland (PhD candidate)** received the GSA Garouk El-Baz Student Research Grant for desert studies. **Yi-Wei Liu (PhD candidate)** received a Sigma Xi Grant-in-Aid of Research.

Rohit B. Warriar (PhD candidate) and **Mathew Domeier (PhD '12)** received Outstanding Student Paper Awards from the Hydrology and Geomagnetism and Paleomagnetism sections, respectively, at the 2011 American Geophysical Union Meeting.

Peter Chutcharavan (BS '13) received a GSA/ExxonMobil Field Camp Scholars award to attend EARTH 440 at Camp Davis.

Mineral Exhibit Award

A University of Michigan showcase of Upper Peninsula copper specimens was awarded Best Museum Exhibit at the Denver Gem and Mineral show this year. Competition included exhibits from the Smithsonian Institution, American Museum of Natural History, A. E. Seaman Mineral Museum, University of Arizona Mineral Museum, Denver Museum of Nature and Science and many others. To win this award, an exhibit need not only have exceptional specimens, but also must present specimens in an educational and aesthetic fashion. The Denver Gem and Mineral show is the largest exhibition to honor museum presentations, making this among the highest honors a museum exhibit can receive. **Chris Stefano (PhD '10)** accepted the award on behalf of U-M at the show's award ceremony.

Our name will be added to a traveling trophy, and the Department will be sent a plaque acknowledging the award.



Joel Blum (Professor) was elected a 2012 Fellow of the American Geophysical Union. This honor is annually bestowed on only 0.1% of the membership of AGU.



Nathan Sheldon (Asst. Professor) was named a fellow of the Geological Society of America.

Scott Tinker (MS '85) was named a Fellow of the Geological Society of America.

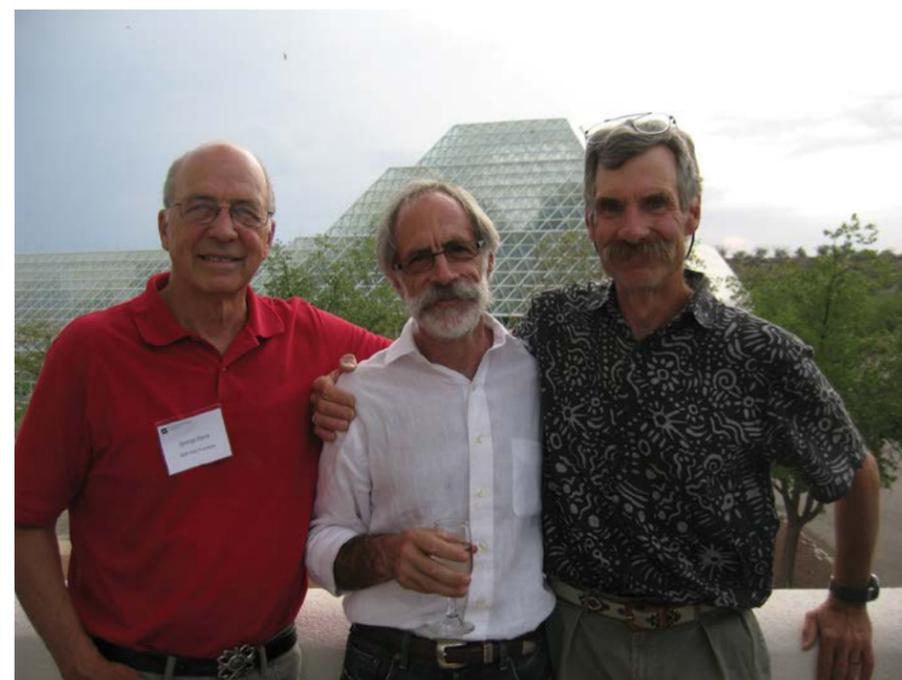
George Davis (PhD '71) will serve as the President of the Geological Society of America for the coming year (see article below).

John Geissman (BS '73, MS '76, PhD '80) is now the Past President of the Geological Society of America.

Peter Vrolijk (UM Post-doc) has been elected a Councilor of the Geological Society of America.

The Three Amigos as Back to Back to Back GSA Presidents

What are the chances of having back to back to back presidents of a professional scientific society be PhD recipients from the same academic institution? To top it off, what are the chances of each of them having the same academic advisor or co-advisor? That is exactly what happened beginning on 1 July, 2010, with **Joaquin Ruiz (MS, 1980; PhD, 1983)**,



and then **John Geissman (BS, 1973, MS, 1976, and PhD, 1980)**, and presently **George Davis (PhD, 1971)** taking turns as President of the Geological Society of America, the oldest professional geoscience society in North America, which celebrates its 125th anniversary in 2013. All three presidents were advised or co-advised by **Bill Kelly**, Professor in the Department from **1956 to 1994**. Joaquin was also advised by **Steve Kesler**, and John by **Rob Van der Voo** (GSA President in 2004-2005).

George Davis, Joaquin Ruiz, and John Geissman (l. to r.) in deep contemplative thought after a long day of a Council Retreat in August, 2011, at the Biosphere Station outside of Tucson, Arizona. Photo courtesy of John Geissman.)

This year, the Geological Society of America highlighted members with 50-year or greater associations with the Society. Among the U-M affiliated members are **David G. Nussmann (MS '61, PhD '65)**, **Henry N. Pollack (PhD '63, Professor Emeritus)**, and **Richard S. Williams (MS '62)**.



*Past U-M faculty member and chair of the department's Alumni Board **Bruce Clark (Professor 1968 - 1977)** and his wife Karen attended the Bruce R. Clark inaugural lecture for **Ben van der Pluijm's** collegiate professorship that was named in Bruce's honor. Bruce, Ben and LSA Dean Terry McDonald at the lecture on 20 October 2011.*

FACULTY NEWS

Ben van der Pluijm recently returned from a year at the National Science Foundation where he helped shape the Foundation's sustainability portfolio of programs ("SEES"); see a short write-up on his experiences elsewhere in this issue. Meanwhile, Ben was able to remain actively engaged in research through the efforts of a group of wonderful students and colleagues. Several publications on aspects of SW US detachment fault systems appeared with Postdoctoral Fellow **Charlie Verdel**, who is now lecturer at University of Queensland, Australia. Graduate student **Tim O'Brien** focused on pseudotachylite dating, which resulted in the first direct age of faulting associated with lapetus opening. Assistant research scientist **Anja Schleicher** published our final(?) publication in a set of original research papers on the San Andreas Fault drilling project. Our collective efforts in this project convincingly confirm the starting working hypothesis of clay minerals as the mechanical agent responsible for weak fault creeping behavior; Ben wrote a short note for Nature Geoscience on this after friction experiments in competing labs demonstrated that SAFOD swelling clays are also very weak in laboratory settings. Post-doc **Elisa Fitz-Diaz** joined the group last year tackling the high-risk, high-reward project of fold dating. Ar dating of folds would complement our now-established fault dating capabilities, allowing detailed spatio-temporal information along and across fold-thrust belts. The preliminary results are very promising, so stay tuned. Three new students will be joining Ben's group this Fall. **Austin Boles** will examine the fluid history of fault systems using high-resolution O-H isotopic analysis of newly mineralized clays in collaboration with colleagues at Wisconsin and Frankfurt. Initial sampling work was done by Ben in

summer 2011. **Samantha Nemkin** will work with Rob van der Voo, Elisa and Ben on the nature and timing of orogenic curvature in Mexico, while **Vera Hehn** will work with Assistant Professor **Eric Hetland** and Ben on microseismicity potential and shale properties associated with hydraulic fracturing in the eastern US.

During the past few years, the research groups of **Professor Rod Ewing** and **Udo Becker** have benefitted from the contributions of undergraduates from a variety of disciplines who have gone on to graduate studies or successful careers. **Semechah Lui** and **Mastura Johari** used atomic force microscopy to investigate radiation damage in micas. This work was presented at an annual meeting of the GSA. Semechah has just begun her graduate studies in the Division of Geological and Planetary Sciences at CalTech. Mastura returned to Malaysia where she works for PETRONAS. **Amber Sue Donley** (NERS), **Chelsea Krummrey** (NERS) and **Matthew Aaron Wall** (Chemistry) contributed to a major review of the applications of nanoscience and nanotechnology to the oil and gas industry. Amber is now a Ph.D. candidate in the actinide chemistry program at Washington State University and Chelsea spent a year in AmeriCorps and is now studying languages in Geneva prior to doing humanitarian work. Matthew's work on radiation damage in phosphates was included in a paper that was published in the American Mineralogist. **Patrick Hastings** investigated uranium-bearing carbonatites from Norway and presented the results at an annual GSA meeting. He also brought order to

the mineralogy teaching collections. Patrick is now a graduate student in the Department of Earth Sciences at the University of Minnesota. **Lindsay Krall** (IOE) completed a study of thorium resources and the thorium fuel cycle. Lindsay was a coauthor on a recent paper on uranium and thorium resources that was published in the Materials Research Society Bulletin. She has completed an internship with SKB, Swedish Nuclear Waste Management Co., and now is a Marie Curie Fellow in a Ph.D. program in the Geology and Geochemistry Department at Stockholm University. **Jejuan Toney** (NERS) helped in the synthesis of zirconate and pyrochlore oxides, potential waste form materials for transuranium elements. He was recently accepted into the M.S. Engineering Management program at Eastern Michigan University and at the same time will work for Michigan Automotive Compressors. **Jason vonEhr** (NERS) worked in the laboratory preparing samples for high-energy irradiations. His review, *Deep Geological Repositories and High-Level Radioactive Waste*, was recently recognized by a Fuel Cycle Research Award by DOE. Jason continues his studies in NERS. Department undergraduates, **McLain Pray** and **Sul Gi Ye Park**, have gone on to graduate studies in Earth & Environmental Sciences at Michigan. McLain has just

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Spectacular exposure of the North Anatolian Fault in Turkey (Photo credit: B. van der Pluijm)

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completed his M.S., an investigation of fission track annealing in apatite, and has taken a job with Schlumberger. Sul Gi Ye is just beginning her Ph.D. program.

Over the summer, **Sarah Aciego (Assistant Professor)** and **Sarah Aarons (PhD candidate)** traveled to UC Irvine to participate, as an instructor and teaching assistant respectively, in the American Indian Summer Institute in Earth System Science (AISESS) for high-school students (grades 9-12). The Summer Institute is spearheaded by alumni **Kathleen Johnson ('96)** to encourage and empower American Indian and Alaska Native high school students to pursue higher education and increase the number of American Indian and Alaska Native students who pursue college degrees in or related to the geosciences. More information can be found at <http://www.airp.uci.edu/aisi.php>.

In the past year, new discoveries of Pleistocene "mummies" from the permafrost of Siberia have kept **Dan Fisher's** lab hopping, and hoping, for still more opportunities to enhance our knowledge of the "mammoth steppe fauna." In February, Yuka, the newest mammoth, was joined by a complete steppe bison and a nearly

complete horse. The logistics are daunting, but we are trying to engineer a visit for all three, plus a woolly rhino and other friends, to a CT-scanning facility with equipment large enough to do them justice. Meanwhile, graduate student **Mike Cherney** and recent undergrad **Zac Calamari**, have taken on major responsibilities for analysis of specimens from the newly discovered Snowmass Village site in Colorado, being worked on in collaboration with colleagues at the Denver Museum of Nature and Science. Snowmass mastodons turn out to have lower (mandibular) tusks that preserve an important record of intra- and interannual variation in growth rates that should be useful for evaluating climate change through a long span of Pleistocene history. In addition, recent undergrad **Ethan Shirley** and current undergrad **Chris Whalen** continue to pull more anatomical information from the CT-scan data from juvenile mammoths Lyuba and Khroma, while undergrads **Caleb Brooks**, **Sarah Fellbaum**, and **Ryan Gabelman** used a laser scanning digitizer and 3D modeling software to generate detailed models of bones from two Great Lakes region mammoth sites currently under study. Toward the end of the summer, Zac, Ethan, Caleb, and Chris joined Dan for a month of fieldwork in northern Yakutia (east-central Siberia). Traveling by small boats and a distinctively Russian tracked vehicle called a vizikhod, they sampled much more of the Russian



Jie Li visiting the Laser Fusion facilities at Osaka University where a laser simulates nuclear fusion.

Arctic than they would ever have thought possible in such a short time, collecting well over a hundred mammoth teeth. Among the sites visited were two that are especially notable for preserving evidence of human-mammoth interaction. As usual, specimens may require a year or more to go through the export permit process and make their way to Ann Arbor, but they will undoubtedly offer many new insights.

Jie (Jackie) Li spent three months in 2012 as a Tharp Fellow at the Lamont-Doherty Earth Observatory of Columbia University. In May she visited the Tohoku University, University of Tokyo, and Osaka University as a Japan Global Center of Excellence Scholar (Photo attached: Jie Li visiting the Laser Fusion facilities at Osaka University where a three-story-sized laser is created to simulate nuclear fusion. In Earth science, intense laser is used to generate ultra-high pressures to simulate conditions in Earth and planetary interiors). In June 2012, Jackie taught a Michigan Math and Science Scholars course "From star to stone" and led a field trip to the Dark Sky Park in northern Michigan. In August, Jackie served as an instructor at the Cooperative Institute for Dynamic Earth Research (CIDER) 2012 Summer School on "Deep Time – How Did Early Earth Become Our Modern World".



Sarah Aciego (Assistant Professor) and Sarah Aarons (PhD candidate) teaching at the American Indian Summer Institute in Earth System Science at UC Irvine.

New Faculty

Adam Simon



Ph.D. 2003
University of Maryland

Economic Geology

My research program is dedicated to improving our understanding of how nature concentrates metals such as copper, gold, platinum, etc. in small volumes of Earth's crust to form ore deposits. I am especially interested in metal ore deposits that are spatially and temporally associated with magmatic systems, namely copper- and gold-porphyry deposits, platinum- and palladium-layered mafic intrusion deposits, and also the possible magmatic origin for Carlin type gold deposits. I enjoy collaborating with industry, academic and government scientists and strive to make the research applicable to the real world. This is done in part by having a research team comprised of students who perform field investigations at economic and barren properties, and students who test field-based hypotheses by conducting laboratory-based experimental investigations. Current projects include:

1. Tracing the origin of gold in Nevada's Carlin type gold deposits, which account for 7% of the total annual global gold production ;
2. Understanding the causes of variation of ore metal ratios (e.g., copper/gold) in porphyry ore deposits;
3. Chemically fingerprinting the source(s) of ore metal fluid(s) in magmatic-hydrothermal environments; and
4. Quantifying the role of degassing on metal mobility in magma chambers.

I am always looking for new research opportunities and am excited to join such a vibrant and storied department.

Penthouse Professors

You may have noticed a few older professors wandering the halls. They hardly ever teach or serve on committees, but frequently show up for departmental seminars. They are not there just for the free cookies and coffee. These are the denizens of the fifth floor penthouse and form the on-site emeriti faculty who are still active in their fields. Here is what they have been up to:

Phil Meyers continues to indulge his interests in the organic geochemical records of past climate changes in the oceans and on continents, and he has expanded his interests to include evidence of changes in the global carbon cycle over the Phanerozoic. With Serena Poli at Eastern Michigan University and Bob Thunell at the University of South Carolina, he has recently published a paper in *Paleoceanography* that describes glacial-interglacial changes in marine productivity during Marine Isotope Stages 13-10 (500-340 ka) over ODP Site 1063 on the Bermuda Rise. He is now working with Serena and Bob to bring together and to understand the paleoceanographic significance of the concurrent evidence for changes in nitrogen cycling at Site 1063 and at Site 1058 on the Blake Ridge in the western North Atlantic. More recently Phil has added studies of peat sequences in Russia and Argentina to his earlier studies of Chinese peat sequences. The peat at these widely separated locations began to accumulate about 15 kybp as their local climates became warmer and wetter after the last glacial maximum. The rates of peat accumulation record subsequent climate changes that affected the competing rates of plant production of organic matter and of microbial decomposition of the deposited material, hence providing local records of Holocene climate changes in the molecular and isotopic compositions of the peat. Phil has also become more heavily involved with the environmental geochemistry group at Universidade Federal Fluminense in Niteroi, Brazil, and particularly with the variety of studies of postglacial climate change that are being done in South America. An outgrowth of this aspect of his activities is the special session on "Continental and Coastal Marine Records of Climate Changes in South America since the Last Glacial Maximum" that he is organizing and co-convening with two of his Brazilian colleagues at the fall AGU meeting in San Francisco. He is also a co-convenor of a special session on "Insights to the Modern and Palaeo Carbon Cycle: Isotopic and Biomarker Perspectives", which is an outgrowth of his participation in the working group on the "Development of Isotopic Proxies for Palaeoenvironmental Interpretation – A Carbon Perspective (DIPPI-C)" that has been initiated by scientists from Durham (UK) University. As part of his participation in DIPPI-C, Phil was a keynote speaker at its first meeting in May in Durham, England and he is presently creating an overview and synthesis of the several excursions to lighter carbon isotopic

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compositions of marine organic matter that have occurred during the Phanerozoic. He looks forward to seeing his many friends in the department who will be at the December AGU meeting.

Earlier this year Bob Owen rotated off the Board of Trustees of the Consortium for Ocean Leadership (COL) but he continues to serve as UM's representative to that organization and on the Policy Committee of COL. He also continues to attend major scientific meetings, and to visit locations (e.g., Baltimore National Aquarium, Arkansas Science Center) to identify possible opportunities for Program in The Environment students to satisfy their internship requirement.

Steve Kesler was a keynote speaker at the Fermor Conference on Ore Deposits in an Evolving Earth in London, England (October) and at the Pan American Conference on Fluid Inclusion Research in Windsor, Ontario (June), where he shared the stage with our new faculty member, Adam Simon. He will present the closing talk at the upcoming SEG conference in Lima, Peru in October of this year. He continues as Special Associate Editor for Economic Geology where he gets all of the strange (and therefore interesting) papers.

Ted Moore is working on material collected during the 2009 Integrated Ocean Drilling Program's (IODP) Expedition 320 to the tropical Pacific. During this cruise complete sections of the Eocene – Oligocene boundary were collected at two sites. These sites, along with a third site collected in 2002, are the only complete Eocene-Oligocene sections ever recovered from the tropical Pacific. In these three sites, Ted and his colleague, Shin-ichi Kamikuri, have detailed the disappearance of over 50 radiolarian species in three step-like episodes of extinction as the Eocene climate cooled and large ice sheets were formed on Antarctica. For pretty pictures of these little bugs see plates in: http://publications.iodp.org/proceedings/320_321/204/204_.htm. Erosion and reworking of sediments at this boundary is common and Ted has examined the likely cause of pervasive erosion and redeposition of Eocene sediments in the Pacific basin. He thinks the erosion results from internal waves on a surface of sharp density contrast in the deep waters that developed as colder bottom waters were formed. These data are contrasted with another interval of common reworking in the near-surface sediments of the tropical North Pacific, where reworking is both directly and indirectly related to hydrothermal circulation in old Pacific crust.

Henry Pollack has had a busy year traveling to high latitudes. In January he accompanied former Vice-President Al Gore to Antarctica aboard the *National Geographic Explorer*. Gore had chartered the ship and invited a group of influential opinion-shapers to let them experience the reality of climate change along the Antarctic Peninsula, a region undergoing very rapid change. Later in the year,

Henry was invited to join an expedition attempting a transit of the Northwest Passage from Nome, Alaska, through the Bering Strait, eastward across the Beaufort Sea, through the Canadian archipelago, and on to Nuuk, Greenland. As it turned out, the passage was virtually ice free, except for one day when the ship encountered moderate, easily navigable sea ice. This past summer the Arctic witnessed a new record low for sea ice extent at the end of the Arctic summer. To put the transit into perspective, it took only three weeks to sail through the Northwest Passage in the summer of 2012, whereas the first successful transit, by the Norwegian explorer Roald Amundsen, took three years to achieve early in the 20th century. When not in the polar regions, Henry is kept busy with the activities related to the several boards on which he serves. One is the National Research Council Board of Earth Sciences and Resources, which meets twice a year, and another is the Biosphere 2 Board at the University of Arizona. The Biosphere is located on a spacious 'campus' near Tucson, which features a huge glass dome covering several acres. Beneath the dome large scale controlled biologic and geomorphic experiments are being conducted. Henry is also serving on the National Science Foundation's review panel of the IRIS (seismologic) and UNAVCO (geodetic) programs, currently being somewhat integrated into two newly renamed entities: Seismological Facilities for the Advancement of Geoscience and Earthscope (SAGE) and Geodesy Advancing Geosciences and Earthscope (GAGE). Henry continues to be invited to speak about his book *A World Without Ice* to a wide variety of audiences around the country. Of special note was the invitation to keynote the annual conference of The Institute of Religion and Science in August. Another was his invitation to be a central figure in a documentary being filmed about ice in the Great Lakes region. This documentary has emphases on the role of ice in creating the Great Lakes, its importance in the annual cycle of the contemporary lakes and in the culture of the region.



Glacially carved topography on Baffin Island, Nunavut Territory, Canada. (Photo: H. Pollock)

Ben@NSF: A professor's experience in the real world ... of DC

In early winter 2011, then Geosciences Assistant Director Tim Killeen approached me with the suggestion to spend some time at NSF working on cross-directorate program activities. A late March dinner with Tim and Deputy AD Marge Cavanaugh finalized the arrangements and I started my one year stint in August 2011. I found a (pricey) 1bedroom apartment in Arlington a stone's throw from NSF, allowing easy transportation to work and to Reagan National Airport. Living on the 15th floor, my vertical commute was about as far as my horizontal commute to work. My IPA assignment was in the GEO Directorate's front office, focusing on the foundation's evolving Science, Engineering and Education for Sustainability (SEES) portfolio that was initiated and led by Killeen, and related activities. I also had a role as program officer in one of the SEES programs, SEES Fellows, which focuses on workforce development by supporting young scientists to enter the sustainability research area with a multi-year grant. Cross-directorate activities at NSF are much like interdisciplinary teaching and research at universities. Everybody talks about it in a positive manner, but execution is complicated by siloed organizational structures. Nevertheless, the commitments among the directorate ADs and NSF leadership (Suresh and Marrett) ensured that significant progress could be made in the development of this investment area. Currently, 16 programs fall under the NSF's SEES portfolio, five of which were finalized when I was there and have recently been posted on the NSF website (<http://www.nsf.gov/sees>).

What is sustainability science? Discussing the term alone can fill several pages, but we define it as:

In a sustainable world, human needs would be met without chronic harm to the environment and without sacrificing the ability of future generations to meet their needs.

Meeting the grand challenge of sustainability requires multi-faceted approaches, with research and education at the nexus of societal needs and behavior, environmental impacts and economic demands. NSF supports this through interdisciplinary, use-inspired research and education programs that reflect the foundation's unique role for the nation. Three goals guide the portfolio's development: (1) Building the knowledge base by supporting interdisciplinary research and education that facilitates the move toward global sustainability; (2) Growing the workforce of the future, by supporting the development of a workforce trained in interdisciplinary scholarship needed to understand and address the

complex issues of sustainability; and (3) Forging critical partnerships, by building linkages among projects and partners, and add new participants in the sustainability research enterprise, including industry and policymakers.

Given the above description, it is clear that the SEES portfolio takes a broad approach, which can group in the following themes :

- Natural Environment – Understanding the natural and living environment, particularly coupled human and biophysical effects on climate systems, hydrologic systems, geologic systems, and ecosystems.
- Human Environment – Focusing, across the full spectrum from individuals to societies, on social, behavioral and economic aspects of environmental sustainability. Such research also seeks to understand how scientific discovery and its development results in societal adaptation and resilience.
- Built Environment – Examining the interaction between technological and constructed systems, such as urban areas, electric grids, cyberinfrastructure, transportation networks, energy resources, materials, and extreme events, in the context of environmental sustainability.

You will find more information on the programs and its goals on the SEES website and in a piece I wrote with Tim and Marge for Eos in early 2012 (<http://www.agu.org/pubs/crossref/2012/2012EO010002.shtml>).

One year at an organization as diverse and complex as the NSF does not allow a full assessment of the enterprise, but I came away impressed with the pervasive commitment to the research and education communities. Leadership, program officers and support staff all share the mission of NSF and are very concerned about the well-being of their respective constituencies. By interacting with leadership and program officers in many directorates, I saw different perspectives and heard alternative opinions, which was most refreshing. Besides the satisfaction of working on an important activity for human society, I also returned

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Earth Camp 2012

Fourteen high school students took part in Earth Camp 2012 this summer, spending two weeks living on campus at U-M and exploring the geology of the surrounding area. The goal of Earth Camp 2012 was to excite students about geosciences – especially those students from underrepresented and disadvantaged groups. The camp also gave high-school students a taste of college life – living in dorms, interacting with faculty, and exploring Ann Arbor in the evenings.

Over half of Earth Camp was dedicated to field trips. Students visited Kelly's Island State Park, where they encountered a spectacular example of glacial striations (the grooves are 400 feet long, 15 feet deep and 35 feet wide!) They also collected fossils in northern Ohio and explored caves 110 feet below ground at Seneca Caverns, one of the only fracture caves available to tour in the US. One of the students' favorite activities of Camp was collecting macroinvertebrates from polluted and pristine streams of Ann Arbor. This macroinvertebrate survey was used to determine water quality, using indicator species as markers of "clean water." None of the students had ever done anything like this before, and they were incredibly excited about being in the water collecting bugs.



Students in Earth Camp create a geologic time scale on the field at the Big House. (Photo: Dale Austin)

(continued from page 11)

intellectually invigorated, and have just started a new First-Year Seminar that deals with sustainability issues (EARTH 159). NSF is a welcoming place for "rotators", encouraging new perspectives and supporting one's personal development, while maintaining focus on the mission of the organization. The personal separation from my wife Lies, who stayed in Ann Arbor for her work, and the resulting commutes between DCA and DTW, were probably the least attractive part of the arrangement. TSA officers at Reagan soon recognized me as I regularly went through the Delta security line (perhaps my tongue

Students were challenged to work together, solve problems, and overcome fears at the U-M Challenge Center's low ropes course. They kayaked the Huron River, hiked the Nichols Arboretum while exploring glacial features, and melted their own (instructor-created) ice cores in the laboratory to reconstruct past-climate change. The bedrock layer below the Diag was located thanks to Peter van Keken's seismic equipment, and students spent time in the Big House using the football field to visualize geologic time.

In addition to gaining experience in the field and exposure to the academic environment of the U-M campus, students spent more time learning about industry at Earth Camp this year. For the 2nd straight year, **Maris** and **Matt Densmore (PhD '08)** from Shell participated in Earth Camp. The Densmores attended a screening and discussion of the new energy documentary, SWITCH, then spent the morning engaging students with hands-on activities. For example, immature shale was heated in a test tube and oil was observed to condense. The top of the test tube was then successfully lit on fire, providing a lucid demonstration of the presence of combustible fossil fuels. They also used a marble cake to demonstrate the strategies used to find drilling locations for oil and gas. Finally, the Pall Corporation gave students a tour of the wastewater treatment facilities at its site to clean up the 1,4 dioxane plume under Ann Arbor and uncapped a monitoring well to show the students how the groundwater plume's progression is monitored.

Efforts to build on this summer residential camp continue, with the goal of sustaining a robust outreach program that engages students with field experiences and draws excellent high school students to the Department for years to come. The 2012 Earth Camp was funded by Shell, the U-M Center for Educational Outreach, the Department of Earth and Environmental Sciences, and a National Science Foundation grant to **Assistant Professor Greg Dick (faculty advisor of Earth Camp)**.

twisting lastname helped their memory). I encourage active scientists to consider a rotation at NSF, because such involvements bring community experiences and perspectives directly to the table. From my own perspective, it'll be interesting to see what happens to the activities that were started and newly proposed for future years during my stay, within a political climate that has an uneven view of science, and sustainability science in particular.

Ben van der Pluijm is the Bruce R. Clark Collegiate Professor of Geology.

Physical Oceanography in Michigan's Earth and Environmental Sciences Department

In 2010, **Assistant Professor Brian Arbic** began work in the Department. Arbic is a member of the group of interdisciplinary climate change faculty who are jointly appointed in both Earth and Environmental Sciences and the College of Engineering's Atmospheric, Oceanic, and Space Sciences (AOSS). Arbic is a physical oceanographer, a field that complements the long and distinguished tradition of paleoceanography in the Department, as well as other climate-oriented research in the Department.

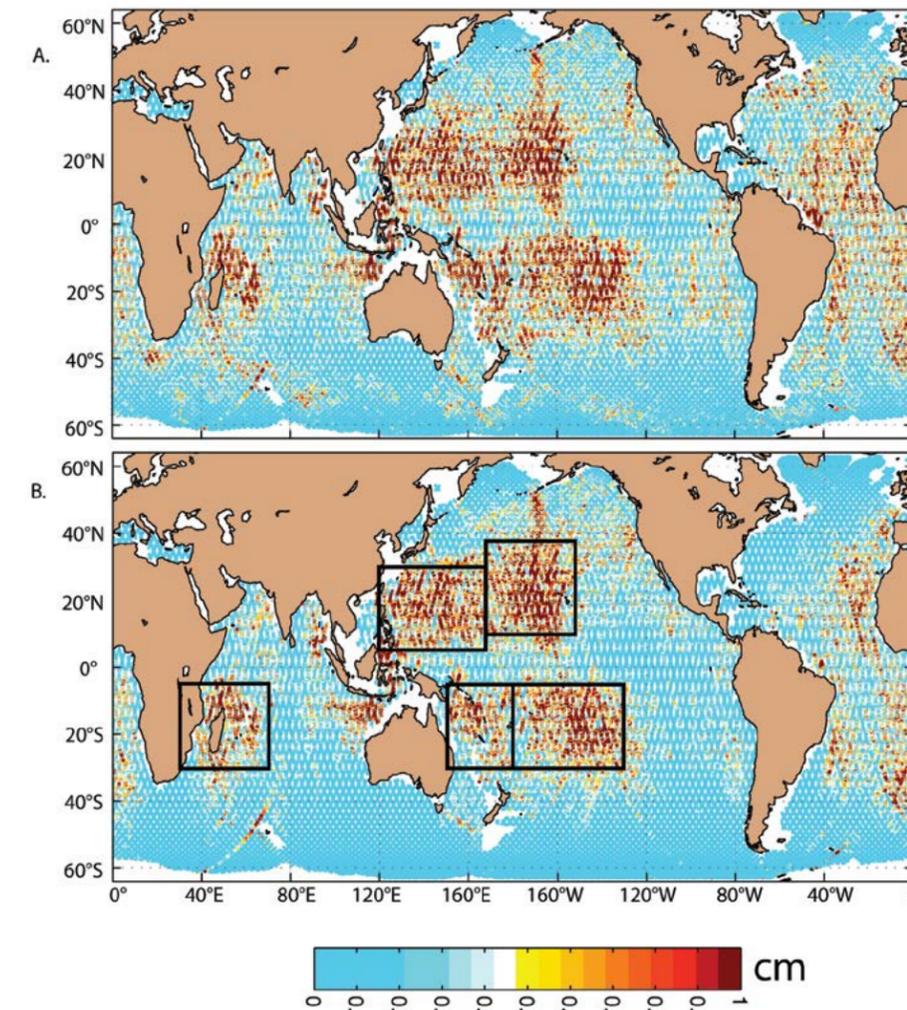
Broadly speaking, physical oceanography is the "physics of the ocean", encompassing topics such as the fluid dynamics of stratified fluids on a rotating planet (geophysical fluid dynamics), ocean optics, physical-biological and physical-

chemical interactions, ocean acoustics, tides, waves, turbulence, atmosphere-ocean interactions, and the role of the ocean in climate. The ocean is a critical component of the Earth's climate system for a number of reasons, including its ability to store and transport large amounts of heat and carbon, and its interactions with other components of the climate system such as the atmosphere and cryosphere.

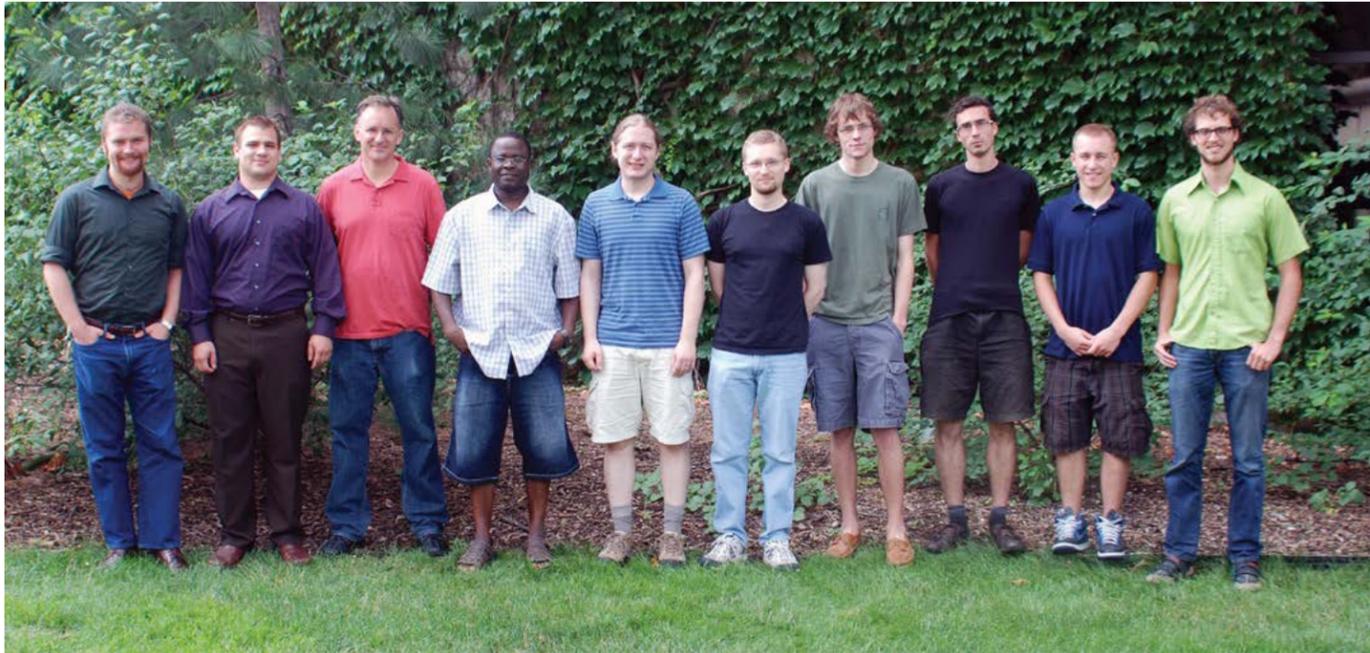
Arbic and his research group focus on the dynamics and energy budgets of oceanic tides, the oceanic general circulation, and oceanic mesoscale eddies. The energy budgets of ocean currents, eddies, and tides are a topic of great interest in the oceanography community today,

largely because the mixing that results when oceanic motions dissipate energy is thought to exert strong controls on ocean heat transport, and the uptake of climatically important nutrients. The ocean tides are forced primarily by the astronomical tidal potential of the Moon and Sun. The general circulation is forced primarily by winds and "buoyancy forcing". (Seawater buoyancy is affected primarily by temperature which is controlled at the sea surface by heat exchange between the ocean and atmosphere, and by salinity which is controlled at the sea surface by differences between evaporation and precipitation). The oceanic general circulation features strong permanent currents such as the Gulf Stream, Kuroshio, and Antarctic Circumpolar Current. Instabilities of ocean currents, especially the strongest currents mentioned above, produce oceanic mesoscale eddies, the ocean's dynamical counterparts to weather systems in the atmosphere. Like weather systems, ocean eddies are transient, and have their sense of rotation determined by the hemisphere they reside in (northern versus southern) and whether or not they are low- or high-pressure systems. Ocean eddies contain most of the low-frequency kinetic energy of the ocean.

(continued on the next page)



Amplitude of internal tide—the tide resulting from ocean stratification—at sea surface from (A) satellite altimeter data and (B) computer simulation run by Arbic's Navy collaborators. Boxes in (B) show "hotspots" of internal tide generation, over which the spatially averaged model internal tide amplitudes agree with those in the satellite data to within about 20% (Plot courtesy of Jay Shriver, NRL).



Left to right: Ben Alterman, Steve Bassette, Brian Arbic, Joseph Ansong, Andrew Morten, Alfredo Wetzel, Brandon Cloutier, David Trossman, Jeremy Upsal, Conrad Luecke. Missing from picture: postdoctoral subcontractor Malte Mueller, former group members Patrick Timko, Aaron Skiba, Libo Zeng, and Caroline Kinstle. (Photo: Dale Austin)

(continued from the previous page)

Arbic and his research group use a variety of tools, including realistic numerical ocean models, idealized numerical models, analytical (“pencil and paper”) models, and observations. The realistic model most frequently employed in the group is HYCOM, the HYbrid Coordinate Ocean Model, which the United States Navy will soon be using as its ocean forecasting model. Arbic has collaborated since 2006 with scientists at the Stennis Space Center branch of the Naval Research Laboratory (NRL) on the implementation and validation of tides in the HYCOM forecast model, which is the highest-resolution global ocean model in current use as well as the first global high-resolution model to include tides alongside atmospherically-forced motions. The HYCOM simulations utilized by Arbic’s group and NRL collaborators are typically run on several thousand processors at once on national supercomputers run by the Department of Defense or National Science Foundation (NSF). For example, recently Arbic and **U-M postdoctoral fellow David Trossman** were awarded an allocation of 10,000,000 CPU hours on the new Yellowstone machine at the NSF-run National Center for Atmospheric Research (NCAR). The observations utilized by Arbic and his group include current meters, satellite altimeter data, and tide gauges. The comparison of ocean models with observations done by Arbic and his group is especially relevant for the development of the HYCOM forecast model with NRL collaborators.

The U-M physical oceanography group is currently primarily funded by NSF and the Office of Naval Research. The Navy-funded HYCOM research is of great interest to

NSF, which is funding Arbic and Trossman to develop an energy budget for HYCOM, and is separately funding the participation of Arbic and **postdoctoral fellow Joseph Ansong** in a special multi-institution Climate Process Team focusing on ocean mixing. The Navy-funded HYCOM research is also of interest to NASA. As a result of this interest, Arbic and his NRL colleagues have been invited to several NASA/European Space Agency planning meetings focusing on the development of the next-generation wide-swath satellite altimeter, the next to take place in Venice in September 2012.

To date fourteen people have been employed in the U-M physical oceanography group, including former **postdoctoral fellow Patrick Timko** (now a project scientist at the University of Bangor in the United Kingdom) and former **U-M undergraduate researchers Aaron Skiba** (now a graduate student in U-M’s Department of Aerospace Engineering), **Libo Zeng** (physics and math major), and **Caroline Kinstle** (recently a summer intern at Los Alamos, now a graduate student in AOSS). Current group members include Malte Muller, who collaborates with the group as a postdoctoral subcontractor from the University of Victoria, U-M postdoctoral fellows David Trossman and Joseph Ansong, **U-M graduate students Andrew Morten** (Physics), **Alfredo Wetzel** (Applied Math), **Ben Alterman** (Applied Physics), and **Conrad Luecke** (Michigan Earth), **U-M undergraduate researchers Steve Bassette** (Physics and Math) and **Brandon Cloutier** (Physics and Complex Systems) and visiting University of Colorado Physics major Jeremy Upsal. Seven of the group members attended the 2012 Ocean Sciences meeting sponsored by the American

Geophysical Union and held in Salt Lake City. Group members have also visited NRL, MIT, Princeton University, NCAR, and the Scripps Institution of Oceanography to consult with collaborators and give professional seminars.

As described in three U-Michigan publications including Michigan Today, Arbic and Ansong first met at Damongo Secondary School in rural northern Ghana, where Arbic taught secondary math and physics as a Peace Corps volunteer from 1990-1992 and Ansong was an O-Level student. After losing touch for many years, they were reunited in November 2010 during a Peace Corps event on campus, after which Ansong was hired into the physical oceanography group.

A few highlights of the research performed in U-M’s physical oceanography group include:

- Development of the first ever global three-dimensional map of tidal currents (Timko).
- The first comprehensive study of the resonance of the global diurnal tides (Skiba, Zeng, and Muller).
- Development of a quantitative diagnostic for the time-mean position of strong currents (Kinstle).
- A pioneering computation of the energy budget in high-resolution ocean models (Trossman).
- Computations of tidal energy fluxes and parametric subharmonic instability (an instability mechanism of great current interest) in the HYCOM simulations

which include tides (Ansong).

- Studies of the potential for oceanic eddies to drive much of the low-frequency variability observed in the ocean, using both idealized (Morten) and realistic (Muller) numerical models.
- The first study of the potential contribution of climatic changes to open-ocean stratification to the observed changes in tides over the last century (Wetzel).
- Development of a data-assimilation scheme suitable for improving the accuracy of tides in the Navy-run HYCOM ocean forecast models (Alterman).
- The first extensive global model-data comparisons of low-frequency (Luecke) and tidal (Bassette) displacements of subsurface temperature contours.
- A study of the impacts of atmospheric storms on ocean mixing (Cloutier, Upsal, and Trossman).

Finally, Arbic’s contributions to the teaching mission of the Department include Introductory Oceanography (EARTH 222/223), Introduction to Physical Oceanography (EARTH 421), and a planned course on Earth and Space Science for Elementary Educators, to be team-taught with colleagues from Astronomy. Arbic’s proudest teaching accomplishment to date is learning the names of virtually all of the 151 students in 222.

Brian Arbic is an Assistant Professor in the Department of Earth and Environmental Sciences

Chris Malvica Receives LSA Staff Spotlight Award



Chris Malvica is the Program Coordinator for the University’s Camp Davis Rocky Mountain Field Station. From May to September each year he lives at Camp Davis, where his responsibilities include everything from food service and meal planning to computer network support. For those five months he is on call 24/7 to support every aspect of Camp operations and management. A true “jack-of-all-trades,” Chris may be found up to his elbows in fresh produce, or under a sink with a pipe wrench. The rest of the year Chris works in Ann Arbor recruiting students for Camp Davis courses, promoting Camp programs, and hiring staff for the coming year. More ambitious projects include ongoing improvements to the Camp’s infrastructure and accommodations — some of which date to the Camp’s founding in 1929.

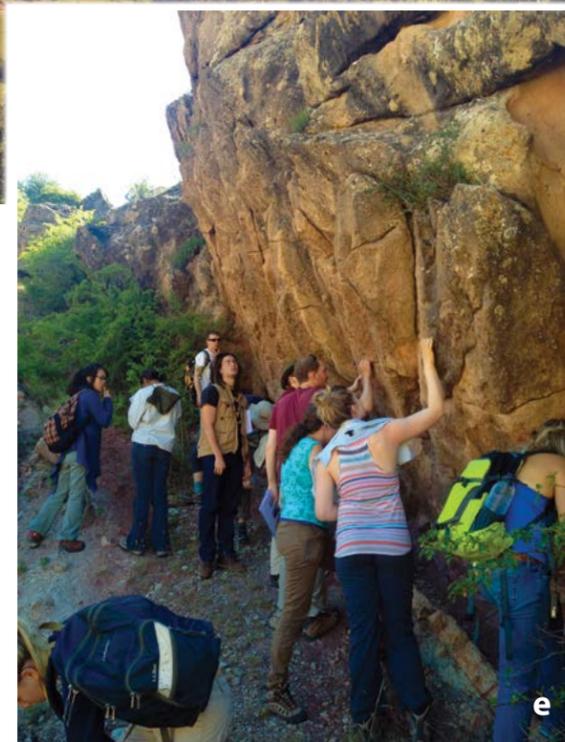
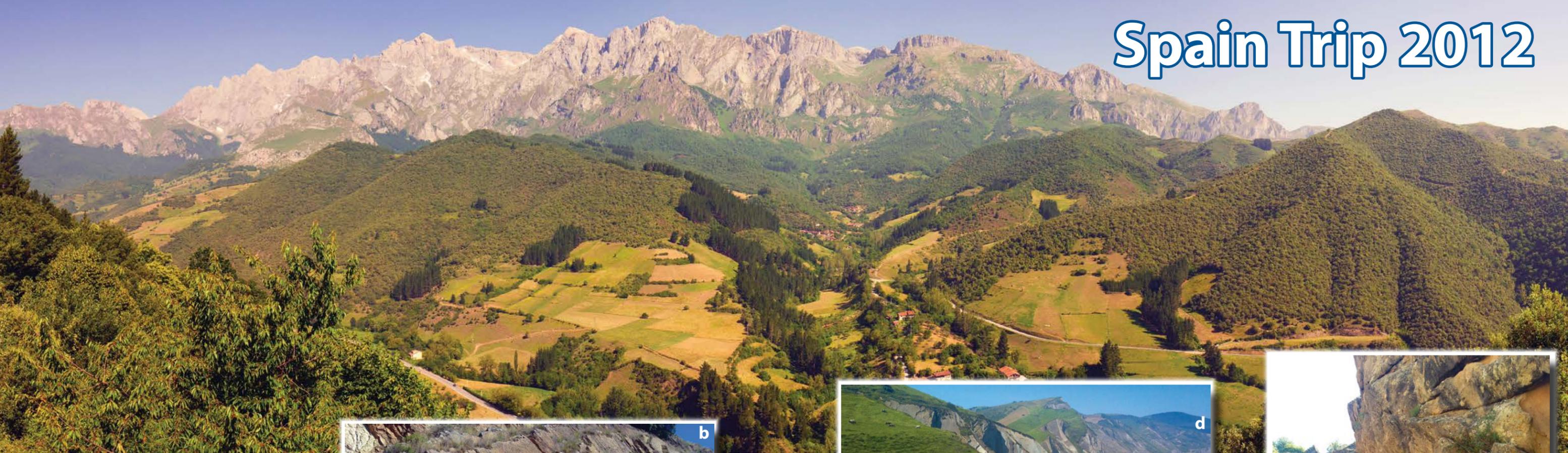
Most of us wouldn’t know where to begin with a range of responsibilities that broad. The answer in Chris’ case is experience. He attended nursing school and worked in a hospital. He made a second career as a chef for the Ritz Carlton Hotel. Always curious and looking to broaden his skill set, he also worked as an electrician. One of the things Chris appreciates about his work at Camp Davis is the variety of challenges he faces. Throw in the diversity of the students and a postcard-perfect location and there is no

better second home for a man of Chris’ unique abilities, and no better coordinator to watch over one of the University’s greatest assets.

Chris makes his home in Chelsea, Michigan, where he lives with his wife. Their two daughters both recently graduated from Michigan State University.

The LSA Staff Spotlight Award recognizes and celebrates achievements and contributions staff make to the successful operation of the college. The Staff Spotlight Committee is composed of eight staff members from across the college. The committee reviews spotlight nominations and makes final recommendations.

Spain Trip 2012



In June, 16 U-M graduate and undergraduate students went on an international field trip to Spain, led by **Professor Kacey Lohmann** and colleagues and students from the University of Madrid. These photos show some of the highlights of the trip. **Top:** The Picos de Europa, named for being the first sight seen by sailors arriving from the Americas. **a:** Double arch at low tide at Playa de las Catedrales near Ribadeo, Galicia. **b:** The group observing sedimentary structures in Triassic siliclastic and carbonate sequences in the Camaros Basin. **c:** Professor Lohmann describing the origin of the Cantabrian Mountains (background). **d:** Students describing Upper Cretaceous marls near the K/P boundary in Zumaia, Basque Country. **e:** Exploring the contact between the Triassic Buntsandstein and Muschelkalk formations. **f:** Group photo at a Roman goldmine in the Las Médulas World Heritage Site, Castile y León.

This trip was generously sponsored by the International Geological Field Excursion Fund from an anonymous donor, the U-M International Office, and the Department of Earth and Environmental Sciences. All photos courtesy of Peter Knoop.

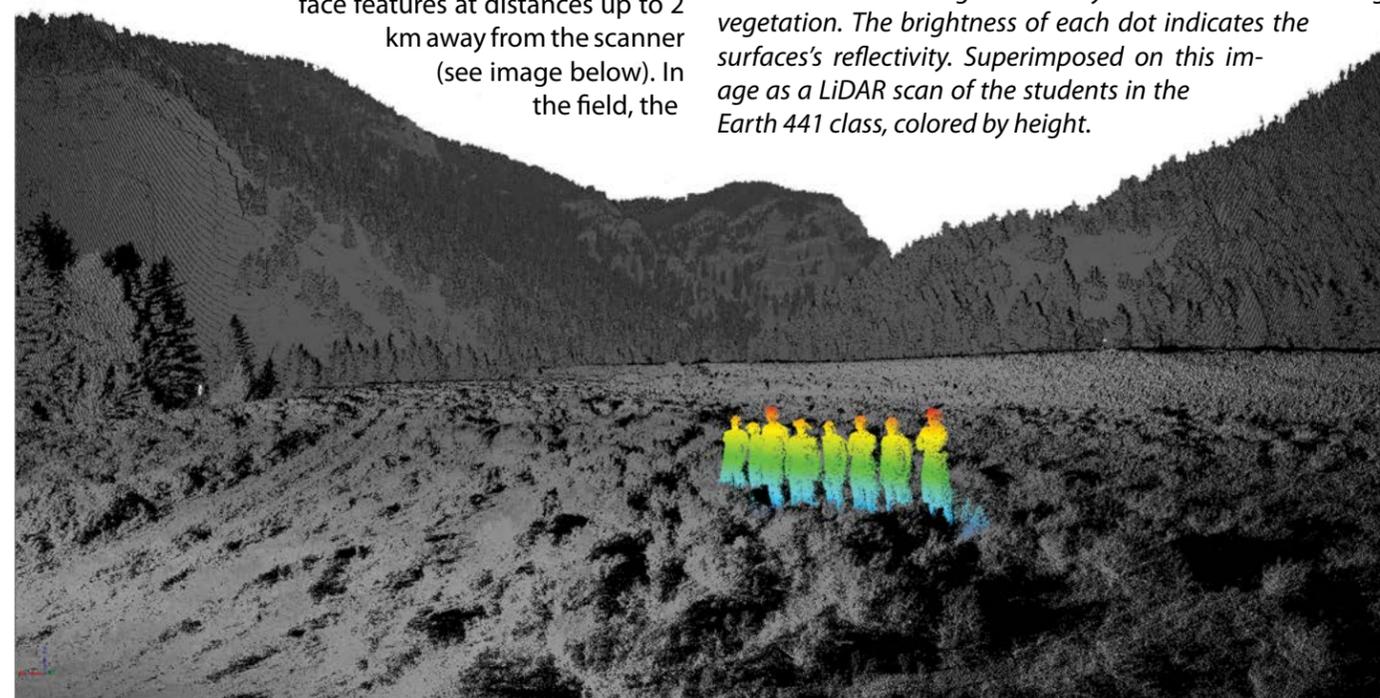
Camp Davis Gazette

Starting last summer, a new class was offered at Camp Davis. EARTH 441, *Field Project*, provides students the opportunity to focus on a single field project for a full week, allowing in depth study of a given topic. For the past two years, the focus of the course has been the neotectonic history of the Jackson Hole region, and has also served as a venue to introduce students to new and evolving technologies used in the Earth Sciences.

This summer, neotectonic studies of the Hoback Fault, which lies just to the south of Camp, and the Grey's River Fault, which lies to the west of Camp, were supplemented with data collected with a Terrestrial LiDAR Scanner (TLS). LiDAR (Light Detection and Ranging) is one of a number of technologies for geodetic imaging. A laser beam is fired from a scanner 10s to 100s of thousands of times per second. The time it takes the laser to bounce off a point on the Earth's surface and return to the scanner is used to measure the distance of that point from the scanner, while the brightness of the returned beam is a measure of the reflectivity of the surface.

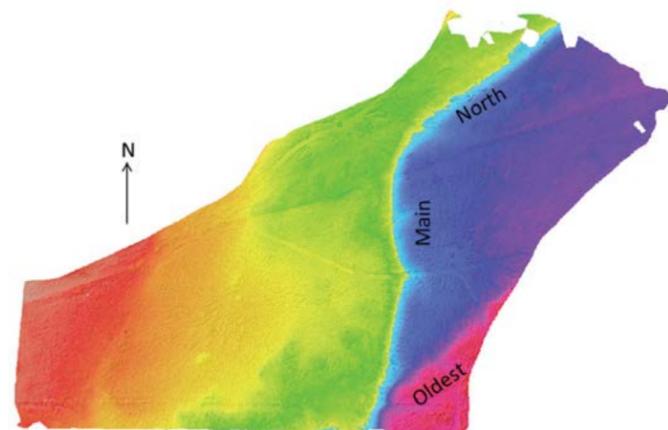
Early LiDAR scanners often weighed hundreds of pounds, and were frequently mounted on aircraft or trucks. New generations of scanners weigh a fraction of this amount and can be backpacked into the field and mounted on tripods for scanning.

The students in EARTH 441 were introduced to the set-up and operation of a Reigl scanner. This scanner is relatively slow, but has incredible range, picking up surface features at distances up to 2 km away from the scanner (see image below). In the field, the

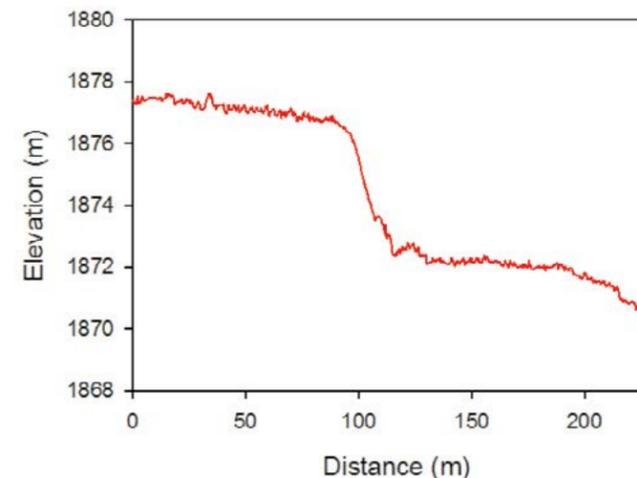


students laid out a survey plan for each fault, determining the minimum number of scanning positions necessary to scan the entire fault scarp exposure. The students then set up highly reflective targets throughout the field area that were used to tie all of the individual scans into a single image. Finally, the students deployed GPS receivers on several of the targets to tie the LiDAR image into a global reference frame.

The raw data from each LiDAR campaign were tens of millions of individual points, their X, Y, Z coordinates, brightness, and, through the incorporation of a high-resolution



Above: A digital elevation model of terrace surfaces at the mouth of Hoback Canyon generated from LiDAR data by 441 student **Megan Mueller (BS '13)**. **Below:** A composite LiDAR image of the mouth of Hoback Canyon, comprised of millions of laser shots reflecting off the canyon walls and surrounding vegetation. The brightness of each dot indicates the surface's reflectivity. Superimposed on this image as a LiDAR scan of the students in the Earth 441 class, colored by height.



Profile across the "Main" scarp at the mouth of Hoback Canyon. See figure at left for approximate location.

digital camera with the scanner, the true color of each data point. Using these data, the students constructed a digital elevation model (DEM) of the Earth's surface around the fault scarps (see color image at left). The construction of these DEMs was not straight forward, and required the implementation of a variety of techniques to digitally "mow the lawn" and remove bushes, trees, fences and power lines from the digital elevation data.

Once a "bare-earth" DEM was created, the students could extract topographic profiles of the Earth's surface across the fault scarps and use this data to assess the amount of potential slip recorded by the offset terrace surfaces, the slope of the scarp, and, from this information, create models of the age of the fault scarp using mathematical models of scarp diffusion rates.

By comparing "diffusion ages" of scarps from multiple locations (Hoback fault, Grey's River fault, and airborne LiDAR data from the Teton fault collected by the National Center for Airborne LiDAR Mapping) the students were able to make assessments of the relative seismic hazard of each of these geologic structures, the relative time since the last earthquake on each faults and the likelihood of future fault rupture, based on fault scarp profile dating.

Camp Scholarship Funds Established

Two new scholarship funds for Camp Davis students were established with generous donations from **Lee and Elizabeth Kornfield** and **Kenneth Grubbs (BS '73, MS '75)**. Camp Davis enrollments have reached all-time highs, while the Department strives to keep course fees affordable and need-based scholarships available. These gifts will have a significant impact on the cost of Camp Davis courses for many deserving students.

A spring storm lifts from Cathedral Rocks and Bridal Veil Falls, Yosemite Valley, California. (Photo: N. Niemi)

ALUMNI NEWS

Tracy Frank (MS 1992, PhD 1996) lives on a small acreage near Lincoln, NE with husband and fellow geologist, Chris Fielding, and a grey cat named Airchie. Following years of toil, the University of Nebraska - Lincoln recently saw fit to promote her to full professor. Rather than using the opportunity to take up golfing, Tracy has agreed to serve as the next editor-in-chief of *Sedimentology*, the journal of the International Association of Sedimentologists (IAS). If you do not hear from her by 2016, you can assume that she met her end in an avalanche of manuscripts.

Paul Goldberg (PhD '73) provided some recent references of the current research he has been doing on the geoarchaeology of the earliest use of pottery, fire, and prehistoric bedding in South Africa and China, including publications in *Science* and *PNAS*.

Mike D'Emic (PhD '11) finished a term as a Visiting Assistant Professor at Georgia Southern University, and started a position as a Research Instructor at Stony Brook University.

Charles Carrigan (PhD '05) was appointed as Director of the University Honors Program at Olivet Nazarene University. It is a part-time appointment, so he's still on the faculty in geoscience, but it does shift his responsibilities around quite a bit.

Derek Raisanen (BS '07) just began his second year of graduate school at the University of Kansas in Lawrence. His Master's thesis is on potential mammal and reptile burrows in the Morrison Formation. In addition to completing field research in the remote canyons of southeast Utah, this past summer Derek also participated in GSA's GeoCorps program. He was one of two Geoscientist-in-the-Park at Capitol Reef National Park. Derek and his colleague led hikes, explained park geology to visitors, and surveyed abandoned uranium mines and Triassic reptile trackways.

Mikey Thomas (BS '10) is right across the street from the Department in the U-M School of Dentistry and currently in his 2nd year of dental school. He took a year off after he graduated in 2010 and continued to work in a research lab at the medical school at U-M in the Department of Cell and Developmental Biology.

Jessica Malone (BS '06, MS '09) has been working all summer on the hydrogeology aspect of the Livengood Gold Project in the taiga of interior Alaska. The environmental

consulting firm she works for (AMEC) is drilling and installing observation and pumping wells in which they will conduct pump tests for aquifer characterization and permafrost studies. If permitted, Livengood will be a large open-pit mine expected to contain 16.5 million ounces of gold.



Jess Malone at an artesian well near the Livengood Gold Project in Alaska. (Photo: Jess Malone)

Robert Keller Vincent (PhD '73) was awarded Professor Emeritus status in the Department of Geology at Bowling Green State University in Bowling Green, OH, on June 30, 2012, after 19 years of teaching and over \$4 million in research grants. For the time period of July 1, 2012 through June 30, 2012, Bob is the District Governor of Rotary District 6600 for NW Ohio, a volunteer position. He plans to consult, also, during the next year and beyond.

Daniel LaLonde (BS '08) just graduated from medical school at Wayne State University and began a residency in Emergency Medicine at St. John Hospital and Medical Center in Detroit.

Stephen Crabtree (PhD '10) has been hired as an Assistant Professor of Geology at the University of Minnesota - Morris.

Franek Hasiuk (PhD '08) left ExxonMobil's research center and is now an assistant professor and Morehouse Faculty Fellow at Iowa State University.

Antonio Arribas (PhD '92), formerly Chief Geologist with Newmont Mining Corp., has been appointed Vice President

Geosciences with BHP Billiton's Minerals Exploration in Singapore.

Allison Yee (BS '11) worked this summer with the Center for Educational Outreach at their Camp Kinomaage. Camp Kinomaage is a week-long, hands-on science summer camp for middle school students from Michigan Native American tribes. Students explored a number of questions about science, language, and culture through investigations at the University of Michigan Biological Station on Douglas Lake, near Pellston, MI.

She worked to adapt an existing middle school inquiry-

based life science curriculum to fit the camp and the needs of the students. The students learned a variety of topics including watershed and ecosystem science, the effects of water quality, and the connections between science and culture. A number of UMBS researchers interacted with the students to share their research interests, including Luke Nave, Scott Herron, Bob Vande Kopple, and Karie Slavik.

Camp Kinomaage also provides youth with the opportunity to interact with U-M undergraduate and graduate students from similar backgrounds. This educational experience is an exciting opportunity for students to meet peers from all over the state of Michigan.

IN MEMORIAM



Boris Avdeev (PhD '11), passed away at the age of 31. He was caught in an avalanche while backcountry skiing in the Sierra Nevada Mountains.

Boris was a native of St. Petersburg, Russia, where he received a bachelor and a master's degree in geology from St. Petersburg State University. He moved to the United States in 2003 to pursue a master's degree in geostatistics from the University of Texas at Arlington.

In 2006, Boris joined our department, where he completed a Ph.D. dissertation on the tectonic evolution of the Greater Caucasus Mountains. Boris had spent the time since graduation refining some new numerical techniques he developed at Michigan for the interpretation of low-temperature thermochronologic data, and had accepted a postdoctoral fellowship at the University of California, Berkeley, to start this year.

A scholarship fund has been established in his name in the Department of Earth and Environmental Sciences to support graduate student research.

Richard W. Benner (MS, '48) passed away on March 1, 2012 at the age of 89 in Lakewood, CO. Dick completed a thesis on the geology of the Lime Peaks area of the Tendoy Mountain in Montana and Idaho, and following his time at Michigan pursued a career in industry. He was employed by Texaco in the Denver area for many years. The Department is grateful for the generous bequest he made to further education in the earth sciences at Michigan.

Eleanor Cochrane (BS '50) passed away on September 13, 2012. She remained a loyal football fan a supporter of the University of Michigan and the Department of Earth and Environmental Sciences.

Margaret Jean Greene of Silverthorne, Colorado passed away on March 21, 2012 following complications from cancer. Jean was born in Escanaba, Michigan and married her best friend, **John F. Greene (BS '63, MS '70)**, in 1963. Together, John and Jean were extraordinary supporters of the Department of Earth and Environmental Sciences, having helped to establish the Pollack Graduate Fellowship. She is survived by John, daughter Karen, son John Kenneth and her mother, Genevieve (LaBumbard) Pierce.

David Wiltschko (Professor '80-'84) passed away on Friday, March 2, 2012 in College Station, Texas at the age of 63. David was born to William and Virginia (Vilander) Wiltschko on February 5, 1949, in Portland, Oregon. He received a bachelor's degree from the University of Rochester and a doctorate from Brown University. David was a professor at University of Michigan before moving to College Station in 1984 as Professor of Geology at Texas A&M University. He was Director of the Center for Tectonophysics and held the endowed Halbouty Chair in Geosciences. David was active in geology field research throughout the United States and Taiwan and was involved in several professional geology organizations and consulted to oil companies worldwide.

David is survived by his wife, Sherry Bame; his children, Alex and Elicia Bame Wiltschko and several brothers and sisters.

Supporters of the Department of Earth and Environmental Sciences 2010-2012

The Department would like to acknowledge the generous individual and corporate gifts it has received over the last two fiscal years (July 1, 2010 – June 30, 2012). These gifts are invaluable in supporting our graduate and undergraduate programs, our education and outreach efforts, and for attracting and retaining the highest quality faculty and staff.

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John Parker
Estate of Violet Pena Y Lillo
Richard Pike and Linda Grossman
James Pi-Sunyer
Nancy Rabe
Leon and Harriet Reiter
Bruce and Jane Renaud
James Rhodes
Charles and Suzanne Ritter
Robert and Kathleen Rosowski
Anne Sanford
Erin Schlemmer
Robert Scholten
Thomas Schooley
Thomas Sherry and Jennifer Durham
Donald Sprague and Donna Wisnyi
Andrea Stancin
Edward C. & Norma E. Stoever Grantor Trust
David and Jean Struthers
John and Mirabel Sweet
Derek Tatlock
C. N. (Tom) and Janice Tinker
John Tyler
John and Andree Valley
Peter van Keken and M. Colleen Currie
Edmond Van Hees
Richard Vian
Lowell and Linda Waite
Stewart R. Wallace Trust (Estate)
Matthew Wasson
Stuart Weinstein
LeeAnne Wolanyk
Richard Wyman
Weixin Xu
William Zempolich
Youxue Zhang and Zhengjiu Xu
Shijie Zhong
Weiming Zhou
Carl Zimmerman
Jessica Zinger

Recent Bachelors Degree Candidates

Concentration Majors	
Lauren Babuska	Geological Sciences BS
Elizabeth Bunin	Geological Sciences BS
Zachary Calamari	Geological Sciences BS
Stefanus Crooijmans	Geological Sciences BS
Imani Dickson	Geological Sciences BS
Adrian Flynn	Geological Sciences BS
Benjamin Gebarski	Geological Sciences BS
Tony Germain	Earth Sciences BS
Mitchell Guc	Earth & Environmental Sciences BS
Marissa Gunnarsson	Geological Sciences BS
Christina Machak	Geological Sciences BS
Steven Mekar	Earth Sciences BS
Keegan Melstrom	Geological Sciences BS
Sul Gi Ye Park	Geological Sciences BS
Paulina Seromik	Geological Sciences BS
Michelle Tracy	Earth & Environmental Sciences BS
Sreya Vempatti	Geological Sciences BS
Wan Aisyah Wan Mohd Kamil	Geological Sciences BS
Christie Wilkins	Geological Sciences BS

Concentration Minors	
Katherine Anderson	Minor -Paleontology BS
Kimberly Baker	Minor -Earth Sciences BA
Bryana Boos	Minor -Earth Sciences BA
Matthew Buch	Minor -Earth Sciences BA
Robin Czerwinski	Minor -Earth Sciences BA
Amia Davis	Minor -Paleontology BA
Lawrence Garber	Minor -Earth Sciences BA
Shelby Goss	Minor -Paleontology BS
Elliot Jackson	Minor -Oceanography BS
Carlos Michelen Strofer	Minor -Oceanography BSE
Danielle Miller	Minor -Earth Sciences BA
Anita Paredes	Minor -Earth Sciences BA
Elizabeth Potter	Minor -Paleontology BS
Erik Rebbe	Minor -Oceanography BS
Emily Thompson	Minor -Earth Sciences BA
Alan Wang	Minor -Paleontology BS

Recent Masters Theses

Xinyang Chen	<i>Pressure-Enhanced Stability of Cementite (Fe³C) with Implications for the Origin of Cohenite in Meteorites</i>
Jingjie Niu	<i>In Situ Investigation of Uranium (VI) Reduction by Iron (II) on Hematite</i>
Andrea Bossmann	<i>Dynamics of Plumes in a Compressible Mantle with Phase Changes</i>
Xiongyu Chen	<i>CO₂ Diffusion in Dry and Hydrous Haplobasaltic Melts</i>
Meredith Dennis	<i>Regional Paleovegetation Records of the Eocene-Oligocene Transition of Montana</i>
Ada Dominguez	<i>On the Behavior of the Geomagnetic Field During the Miocene</i>
Ethan Hyland	<i>Representational Bias in Phytoliths from Modern Soils of Central North America: Implications for Paleovegetation Reconstructions</i>
J. McLain Pray	<i>The Morphology of Etched and Unetched Ion Tracks in Apatite as a Function of Orientation and Thermal Annealing</i>
Rachel Sortor	<i>No Evidence for a Deglacial Intermediate Water ¹⁴C Anomaly in the Southwest Atlantic</i>

Recent Doctoral Dissertations

Mathew Domeier	<i>Reconciling Paleomagnetism and Pangea</i>
Laura Sherman	<i>Mercury Cycling and Anthropogenic Mercury Pollution: Investigations Using Mercury Stable Isotopes</i>
Jing Zhou	<i>The Mid-Cretaceous Greenhouse Climate and Marine Stable Oxygen Isotope: Insights from General Circulation Model Experiments</i>

Donor - Funded Scholarships/Fellowships Fall 2011 through Fall 2012

Spain International Geologic Field Trip

International Geological Field Excursion Fund:

William Defliese, Madeline Dibble, Sae Yun Kwon, Kaitlin Ma, Keegan Melstrom, Catherine Vatsis

Camp Davis Scholarships

BP Field Camp Fellowship: Peter Chutcharavan, Lindsey Eldredge-Fox, Gen Ito, Tess Nugent

Judith H. Turneure Memorial Student Aid: Brigid Lynch, Mary Gallagher, Carrie Glauner, Maxwell Lewis, Zachary Menzo, Anna Snoeyink, Emily Southern

Shell Camp Davis Fellowship: Peter Chutcharavan, Nathan Kossey, Raoul Martin, Brigid Morse, Anna Sedlar, Patrick Temple, Heather Williams

Graduate Fellowships

BP Graduate Fellowship: Meghan Wagner

Chester B. Slawson Memorial Fund: Xiaofei Pu

Earnest A. Novak Scholarship Fund: William Defliese, Louise Jeffery

F. S. Turneure Fund In Geology: Lydia Staisch

Henry N. Pollack Graduate Fellowship in Geological Sciences: Laura Sherman, Meghan Wagner

Joseph and Anna Drobek Trust: Michael Cherney

Russell C. Hussey Scholarship: Joseph El Adli

Shell Scholarship: Louise Jeffery

Stewart R. Wallace Fellowship: Tao Wen, Alexander Voorhies

Susan M. Kruger Scholarship Fund: Michael Broersma

Violeta Pena y Lillo Scholarship: Lydia Staisch

W.H. Hobbs Fellowship in Geology: John Fronimos, Yi-Wei Liu

Corporate Connections



Matt Densmore (PhD '08), now with Shell, performs a demonstration at Earth Camp in summer 2012.

Internships and New Jobs in Industry

Ada Dominguez (BS '10, MS '12) did an internship at BP last summer, while **Lorena Medina Luna (PhD candidate)** did an internship at Shell. **Liz Tanis** (an incoming graduate student working with new faculty member **Adam Simon**) also interned at Shell, in New Orleans, where she connected with **Alex Janevski (PhD '10)**, who is now employed at Shell in New Orleans. **McLain Pray (MS '12)** just completed his Master's degree with **Professor Rod Ewing** and has taken a job with Schlumberger in Pittsburgh. **Nora Lewandowski (MS '10)** has relocated to San Francisco, where she now works as a staff geologist at Lettis Consultants International.

Scott Tinker (MS '85) worked with filmmaker Harry Lynch to develop a feature length documentary film on energy, its production, efficiencies, and the challenge of switching to new energy sources. The film is designed to educate general audiences on this important and complex topic. A screening of the film took place on campus in June at the College of Engineering, and a discussion afterwards was hosted by **Matt Densmore (PhD '08)**, currently with Shell. Additional screenings are planned around the country. Many of the screenings are sponsored by the Geological Society of America Energy Program, including the Department-sponsored screening in Ann Arbor, hosted by Scott Tinker, on October 18, preceding the annual meeting of the Department's Alumni Advisory Board. To find a screening near you, visit <http://www.switchenergyproject.com>.



Recruiting

Some familiar faces are returning to the Department this fall as Shell, ConocoPhillips, Schlumberger and BP have all scheduled recruiting trips. **Eva Moldovanyi (MS '82)** and **Jason Mailloux (BS '06)** are on the recruiting trail for ConocoPhillips. **Steven Ownby (PhD '07)** passed through while recruiting for Shell in September, as he has for the last 5 years or so. He was joined by **Katy Keller (PhD '06)** to interview our students. Steve and Katy took time during their visit to talk with **Assistant Professor Nathan Sheldon's** Basin Analysis class about job prospects and expectations in the petroleum industry.



Megan (Tuura) Ortega (BS '07, MS '08) and **Tim Cosma (PhD '07)**, both with ExxonMobil, join **Kacey Lohmann (Professor)** to cheer on Michigan at the Alabama-Michigan football game at Texas Stadium in September.



Chair: Rebecca A. Lange

Faculty: S. Aciego, B. Arbic, J. Bassis, T. Baumiller, U. Becker, J. D. Blum, R. Burnham, G. A. Burton, M. A. Carroll, M. C. Castro, M. K. Clark, G. Dick, R. C. Ewing, D. C. Fisher, M. Flanner, P. D. Gingerich, I. Hendy, E. Hetland, R. A. Lange, J. Li, K. C. Lohmann, D. C. Lund, N. A. Niemi, C. J. Poulsen, J. Ritsema, L. J. Ruff, N. D. Sheldon, A. C. Simon, A. Steiner, B. A. van der Pluijm, R. Van der Voo, P. van Keken, J. A. Wilson, Y. Zhang.

Visiting Faculty, Research Scientists and Postdoctoral Fellows: J. C. Alt, C. Badgley, Y. Chen, B. Chen, J. Demers, E. Fitz-Diaz, A. Fuentes, J. W. Geissman, J. D. Gleason, C. M. Hall, S. Huang, B. Kennedy, M. Lang, M. Li, W. Li, S. Montemayor, G. Moore, M. Morishige, J. Naliboff, A. G. Nelson, Z. Rak, D. Reed, A. Schleicher, C. Sheik, S. Smith, L. Sherman, C. Stefano, E. Stevenson, D. Trossman, M. Tsui, J. W. Wang, I. Zalmout, F. Zhang, G. Zhang, J. Zhang.

Lecturers and Adjunct Faculty: M. Arnaboldi.

Emeritus Faculty: C. B. Beck, W. C. Kelly, S. E. Kesler, P. A. Meyers, T. C. Moore, S. B. Mukasa, J. R. O'Neil, S. I. Outcalt, R. M. Owen, D. R. Peacor, H. N. Pollack, D. K. Rea, G. R. Smith, J. C. G. Walker, L. M. Walter, B. H. Wilkinson.

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The Regents of the University: Julia D. Darlow, Ann Arbor; Laurence B. Deitch, Bingham Farms; Denise Ilitch, Birmingham; Olivia P. Maynard, Goodrich; Andrea F. Newman, Ann Arbor; Andrew C. Richner, Grosse Pointe Park; S. Martin Taylor, Grosse Pointe Farms; Katherine E. White, Ann Arbor; Mary Sue Coleman (ex officio).

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Back Cover: Late spring snow on the Kunlun Mountains, northern Tibetan Plateau. (Photo: Petr Yakovlev)

Opposite Page: Cathedral Beach, Spain. (Photo: Peter Knoop)

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