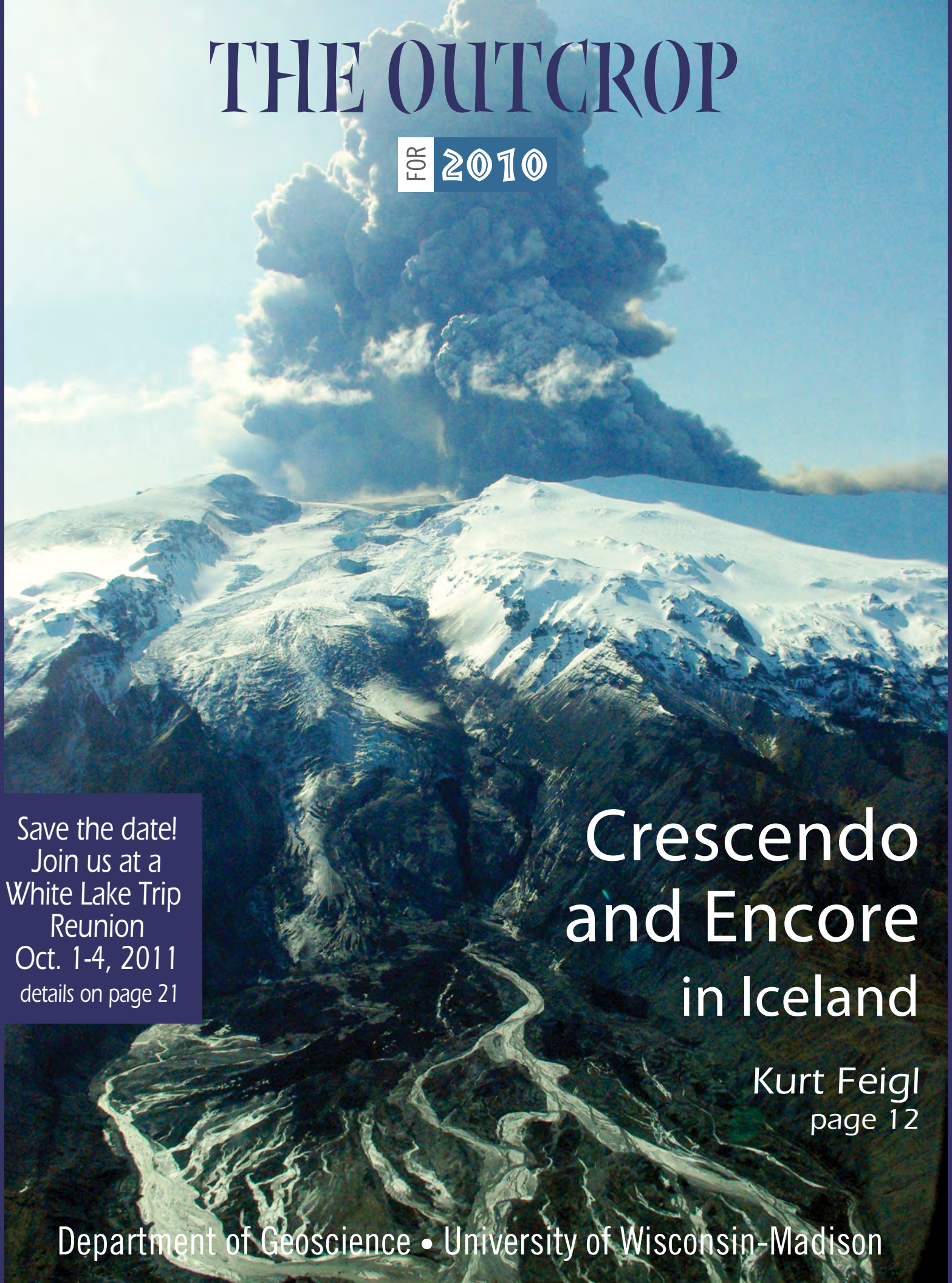
THE OUTCROP

FOR 2010



Save the date!
Join us at a
White Lake Trip
Reunion
Oct. 1-4, 2011
details on page 21

Crescendo and Encore in Iceland

Kurt Feigl
page 12

Department of Geoscience • University of Wisconsin-Madison

2010 THE OUTCROP

The Outcrop:

John Valley–Faculty Liason (valley@geology.wisc.edu)
Mary Diman–Editor (diman@geology.wisc.edu)
Bob Dott–Department Historian (rdott@geology.wisc.edu)

The Outcrop is supported entirely by alumni gift funds.

Published March 2011

Please notify the department if you have a mailing address or email address change. The UW Alumni Association or US Postal service may not share new information with us.

We'd like to hear from you! Send professional and personal updates, feedback, news and photos for *Outcrop 2011* (will be published spring 2012) to:

The Outcrop c/o Mary Diman
Email: diman@geology.wisc.edu
Phone: 608-262-5358
Fax: 608-262-0693
1215 W. Dayton St., Room 239
Madison, WI 53706

The Outcrop on the web:
http://geoscience.wisc.edu/geoscience/about/outcrop

Please join us:
GEOBADGER ALUMNI RECEPTIONS AT MEETINGS IN 2011:

- **AAPG in New Orleans**, Tuesday, April 12, 2011, 5:30-7:30PM
  Room 340B, Hilton Americas, 1600 Lamar St., Houston, TX, 77010
- **GSA in Minneapolis**, Monday, October 9, 2011
  Room location and time to be announced
- **AGU in San Francisco**, Tuesday, December 6, 2011
  Room location and time to be announced

Department of Geoscience
University of Wisconsin-Madison
Lewis G. Weeks Hall for Geological Sciences
1215 West Dayton Street
Madison, Wisconsin 53706-1692

Phone: 608-262-8960
Fax: 608-262-0693
E-mail: geodept@geology.wisc.edu
www.geoscience.wisc.edu

Cover Illustration: Eyjafjallajökull volcano in Iceland erupting for the second time in 2010. Lava broke out through a new vent under the ice-capped summit. The resulting plume rose high into the atmosphere, disrupting air traffic for weeks.
Photo on April 17th, 2010 by Eyjólfur Magnússon, University of Iceland.

Read the cover article by Kurt Feigl on page 12.

Printed on 100% recycled paper.

DEPARTMENT of GEOSCIENCE
UNIVERSITY OF WISCONSIN MADISON

Dear Alumni and Friends,

We are pleased to send to you the 2010 edition of *The Outcrop*. My sincere thanks once more to graphic artist Mary Diman and Professor John Valley, and all the contributors, for providing an informative, photo-filled overview of what GeoBadgers have been up to lately.

2010 was a year of many highlights. From honors and awards to fabulous field trips to new laboratory instrumentation, there has hardly been a moment to allow one to step back and consider the breadth of remarkable activities and achievements 2010 has brought for GeoBadgers.

The new curriculum for our undergraduate majors, which officially takes effect in fall 2011, and a sharp increase in Geological Engineering majors together seem to have sparked a dramatic increase in the number of majors in our department. A recent count put the number of majors at 84 compared to 59 a year ago. I expect this upward trend to continue.

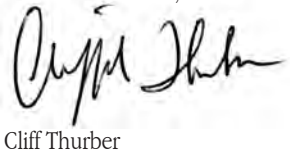
The cover story by Professor Kurt Feigl (pages 12-13) provides personal insight into the scientific response to a volcanic crisis, the eruption of Eyjafjallajökull (say that three times fast). Volcano studies have been expanding in Weeks Hall, leading to several current efforts to pursue joint projects involving geodesy, seismology, geochronology, and geochemistry.

A few words about the earthquake, tsunami, and subsequent nuclear disaster in Japan seem appropriate here. What is transpiring serves as a stark reminder of the power of nature and the need for careful consideration of potential geologic hazards in land use planning and especially for the siting and design of critical facilities. Our hearts go out to all those impacted by this multi-disaster. My hope is that scientists, engineers, politicians, and society in general will learn valuable lessons from what has taken place.

This is my last *Outcrop* cover letter as I prepare to turn the reins over to Professor Brad Singer. As you all know, 2011 has started out in a rather complicated way for UW and for the state (understatement of the year). With any luck, people with heart and foresight will find a path forward that will keep Wisconsin and UW-Madison strong. I know you will all do your best to help make Brad's term as chair a productive and successful one.

Please keep us informed of your personal news and activities so we can continue to update our alumni and friends on the exciting things GeoBadgers are doing around the world. Thanks!

Best wishes to all,



Cliff Thurber
Professor and Department Chair

The Board of Visitors' meeting, September 24, 2010: Left to right, front, Charles Andrews, Don Cameron, Cliff Thurber (Department Chair), Bill Morgan (Board Chair), Doug Connell, Carol McCartney, Robert Nauta, Tom Hoffmann, and Tim Carr. Back, Jamie Robertson, Mark Solien, Tom Johnson, Tom Holley, Kirt Campion, Jay Nania, and Dave Stephenson. *Photo, Mary Diman.*

The Board of Visitors

Thank you from the Board of Visitors for the strong support you have shown the Department this past year. The Board itself was active in several areas during 2010.

A subcommittee of Board members and **Mary Anderson** prepared a document summarizing the history of the hydrogeology program in the Department. This was part of an effort by the Board in support of the Department's request for a faculty position to replace Mary, who retired last year. To the delight of all, this position was approved by **Dean Gary Sandefur**. The Board had the opportunity to personally thank Dean Sandefur for approving the hydrogeology position during his visit to the Board's meeting in September.

At the Board's fall meeting, we had the pleasure of attending a reception and tour of the Wisconsin Geological and Natural History Survey core repository and education center in Mt. Horeb, hosted by **Carol McCartney** (a Board member) and the staff. Several years ago, the Board was instrumental in helping find a home for the irreplaceable cores and samples now housed in the core repository. This is an excellent facility and one that is being used by Department students and faculty. A better understanding of Wisconsin geology will likely result from the easy access to core and sample material that is now available.

The Board is entering the final years of its fund-raising efforts for the **Student Field Experience Fund** campaign. This fund is being established to ensure that field experiences, which have had such positive influences on UW geoscientist graduates (including the Board members), continue to play a vital role in the education of future Department of Geoscience students. To date this fund-raising effort has received commitments in the form of gifts, pledges, and bequests of just under $1.6 million. A subcommittee of the Board, led by **Mark Solien**, has been investigating ways to move us closer to the campaign goal of $2 million. To this end, ***the Board has initiated a matching gift campaign to encourage new donors to the Student Field Experience Fund. Board members have committed $50,000 that will be used to match first-time gifts to this fund made in 2011.*** This is a great opportunity for new donors to make the most of their contributions (information on contributing can be found on page 36 in this issue of *The Outcrop*).

Especially during a time of reduced budgets, your contributions to Department activities are important. In addition to the Student Field Experience Fund, there are many other activities worthy of your donations, including Geology Museum activities and student scholarships, to name just two. **Anne Lucke** of the UW Foundation (608-262-6242, anne.lucke@supportuw.org), who assists the Board with its fund-raising activities, is always happy to provide you with information on donation options that best meet your particular desires and circumstances.

The Board's next meeting will be in April in association with a campus-wide Board of Visitors meeting and the Spring Banquet. We will be planning a mentoring event for students either for that meeting or the one in the fall.

Finally, on behalf of the entire Board, I want to thank **Tom Johnson**, whose term as Chair of the Board ended last spring, for his outstanding leadership during the past several years. Tom's excellent organizational and people skills, combined with his strong commitment to the Department, resulted in several successful initiatives that have directly benefitted the Department. We look forward to Tom's continued presence and advice on the Board in his role as a Senior Advisor.

The Board is always pleased to hear your comments and would welcome your suggestions for nominations to serve on the Board. Thank you again for your support of the Department of Geoscience.

William A. Morgan
Chair, Department of Geoscience Board of Visitors
w.a.morgan@conocophillips.com

Board Members

William Morgan, Chair
w.a.morgan@conocophillips.com
Charles Andrews
candrews@sspa.com
Donald Cameron
dcameron@bemagold.com
Kirt Campion
kmcampion@marathonoil.com
Timothy Carr
tcarr51@gmail.com
Doug Connell
dconnell@barr.com
Steven Driese
steven_driese@baylor.edu
Maitri Erwin
maitri.vr@gmail.com
Thomas Hoffmann
hoffman.tf@gmail.com
Thomas Holley
tkholley@uh.edu
Alfred James
alfred.james55@yahoo.com
Claudia Mora
claudia_mora@q.com
Mark Solien
masolien@gmail.com
David Stephenson
4.geology@gmail.com

Senior Advisors

Kenneth W. Ciriacks
kwcir@msn.com
James F. Davis
jamesdavis93@comcast.net
David Divine
dld1761@aol.com
Mark Emerson
markee@mindspring.com
Carl A.P. Fricke
cfricke@cimacapital.com
Thomas Johnson
tom.johnson@arcadis.com
John W. Mack
JohnMJmack@cs.com
Carol McCartney
mmccartney@wisc.edu
Jean Morrison
morrison@bu.edu
Jay Nania
Jay.Nania@bp.com
Robert Nauta
rjnesllc@charter.net
Marjory Rinaldo-Lee
mrinald1@twcny.rr.com
James D. (Jamie) Robertson
jdrrannoch@sbcglobal.net
Rick Sarg
ricksarg@msn.net
Phillip "Pete" Stark
Pete.Stark@ihsenergy.com

Student Field Experience Campaign

The Board of Visitors of the UW-Madison Geoscience Department established the Student Field Experience Campaign with a goal of building a $2 million endowment to provide ongoing support for undergraduate and graduate student field experience education.

The UW-Madison Department of Geoscience has a long tradition of training undergraduates and graduates in the critical skills of field observations, measurements, and interpretation.

In addition to rapidly evolving technologies that are now important elements of the current geoscience curriculum, it is imperative to continue providing students with field-based experiences, which provide an invaluable component of the traditional geological education.

Challenges

For many years, expenses for course-related field trips were covered by the educational budget provided by the State of Wisconsin. However, in recent years, decreasing state budgets for educational expenses and increased costs have forced the Department to rely almost exclusively on gift-funds, plus modest field trip fees, to support educational field experiences. Furthermore, university support for Geology Museum summer fossil collecting expeditions to Wyoming ended in 2005.

Double your gift!

Starting this spring, new gifts to the Student Field Experience Fund will be matched 100% by the Geoscience Board of Visitors. Board members have committed over $50,000 to match all new gifts to this fund (gifts will be matched until the total pool of BOV funds is committed). If you have not yet contributed to the Student Field Experience Fund, take advantage today of this great opportunity to double the impact of your support for GeoBadgers in the field around Wisconsin and around the world.

Campaign Goal

The goal of this campaign is to build a permanent endowment fund of two million dollars to support student field trips, field camp tuition scholarships, and museum field activities to sustain field experiences for decades to come.

Campaign Progress

Through the generous donations and pledges from very dedicated alumni, and with a gift from Marta Weeks, we are on our way to realizing the $2 million goal. With the generous support from you, our friends and alumni, we are confident that we can achieve our goals so that UW-Madison represents the very best in geoscience education.

Donations to the Student Field Experience Fund can be designated for Student Field Experiences and/or for Museum Field Experiences. Donations to the Student Field Experience Fund can be made in several ways, including direct gifts, multi-year pledges, matching gifts, appreciated securities, and estate giving commitments. Donation pledges can be made for a multi-year period.

Gift Levels

There are several gift levels that recognize different contribution amounts (funding level is inclusive of matching corporate grants):

Estate gifts or deferred gifts of $25,000 and above can be applied to this campaign and also qualify for membership in the Bascom Hill Society.

For more information please contact:
Anne Lucke, UW Foundation
1848 University Avenue, Madison, WI 53708-8860
Phone: 608-262-6242
Email: Anne.Lucke@supportuw.org
or
The Department of Geoscience
1215 W. Dayton St., Madison, WI 53706

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Undergrads in an intro structure class sketch an outcrop. *Photo, M'Bark Baddouh.*

Gifts to the department in 2010: *Thank you*

Gifts toward the end of the year may have been recorded for 2011

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GLE and Geoscience student Lauren Meyer collects magnetic data during the Geoscience 595 Field Trip to the Upper Peninsula, MI. *Photo, Craig Benson.*

Distinguished Alumni Awards *for 2010*

MARJORIE A. CHAN

For distinguished contributions in the fields of sedimentary geology, basin analysis, stratigraphy and planetary geology; and for being an exemplary role model for young women in the field of geoscience through outstanding educating and mentoring of students.

Marjorie Chan

Marjorie A. Chan (Ph.D. 1982), a native of northern California, earned the B.S. from UC-Davis and then came to Wisconsin for graduate work with Bob Dott. She held a graduate fellowship throughout her Ph.D. program and also a Knapp Residential Fellowship for a small, select group of graduate students. Marjorie's dissertation was titled *Comparison of Sedimentology and Diagenesis of Eocene Rocks, Southwest Oregon*.

Chan joined the faculty of the University of Utah in 1982 after completing her Ph.D. degree. At Utah, she has broadened her research greatly, having published about Late Proterozoic tidal deposits near Salt Lake City, eolian Jurassic sandstone deposition and diagenesis on the Colorado Plateau, and drawing analogies between diagenetic iron concretions in those sandstones and similar "blueberry" nodules found on Mars.

Marjorie has also been a leader in promoting careers for young women in science, for which she has received awards and recognition in local and national media. She has been a leader in growing efforts to preserve classic geological sites, for example the Stockton gravel bar of Utah's Pluvial Lake Bonneville, which was described by G. K. Gilbert in his 1890 classic U.S. Geological Survey Monograph No. 1 about Lake Bonneville.

In 2002 Chan began a seven-year term as Chair of her Department of Geology and Geophysics. Her exceptional effectiveness in that office brought invitations to apply for other administrative positions. Her proudest achievement as Chair was seeing the completion of a new building for her Department in 2009. This project was made possible by a generous gift of seventeen million dollars from Reverend Marta Weeks in memory of her father, who was a 1917 geology graduate of the University of Utah. Coincidentally, Marta married Austin Weeks, the son of our own Department's great benefactor, Lewis G. Weeks, geology graduate of the UW class of 1917. Those of us who have seen the Utah building agree with a testimonial that the Frederick A. Sutton building is "the most spectacular and interesting geology building I have been in." This is due considerably to Marjorie Chan's tireless efforts in recruiting gifts and in paying close attention to the infinite number of details that arise in designing displays for a complex building.

Considering her outstanding contributions to science, to education, and as a role model for young women, Professor Chan is clearly one of our most distinguished alumni.

—Robert H. Dott, Jr. Citationist

JOHN M. EILER

For distinguished contributions in the field of isotope geochemistry, including innovative theoretical, analytical and empirical contributions to understanding processes of isotope ordering, thermometry, and exchange, and applications to fundamental questions in geoscience.

John Eiler

John M. Eiler (M.S. 1991; Ph.D. 1994) is the Robert P. Sharp Professor of Geology and Geochemistry at California Institute of Technology and Director of the Caltech Center for Microanalysis. John grew up in Madison and graduated from West High and the University of Iowa. He completed his M.S. and Ph.D. degrees at the UW-Madison working with Professor John Valley in the Adirondack Mountains. His thesis included one of the first geological applications of ion microprobe analysis to oxygen isotopes in rocks. From Madison, John moved to Caltech where he rose rapidly through the ranks from post-doc to full professor in less than eight years.

Over the past 20 years, John's creative and interdisciplinary research has ventured widely across the geoscience landscape, making fundamental contributions to many different areas. At the same time, he has changed how stable isotope geochemistry is practiced and how measurements are made. The hallmarks of John's career are his willingness to revisit and challenge difficult or previously intractable problems, often formulating new theory or undertaking the development of new analytical techniques, and his versatility as a scientist. The breadth of John's intellectual curiosity, technical creativity, and scientific productivity make it difficult to encapsulate his many contributions. He is as comfortable intellectually delving into the kinetics of oxygen exchange in metamorphic minerals and as he is the formation of soil-carbonates on Mars or air pollution in L.A. His studies of volcanic rocks created a new tool for basalt petrogenesis and changed the prevailing view of oxygen isotope geochemistry in the mantle. He developed a new technique to measure ultra-small quantities of hydrogen in order to study the hydrogen isotope composition of water vapor entering the stratosphere, the global atmospheric budget of H_2, and the possible effects of leakage in a hydrogen economy. He has invented a new field called "clumped isotope" geochemistry based on preferential formation of bonds by heavy isotopes that provides new estimates of paleotemperature with applications such as the formation of carbonate minerals in molluscs, paleoclimate estimates from stalagmites, or body temperatures of dinosaurs. He has advised 17 graduate students and 24 post-docs.

John has received numerous prestigious awards including a Packard Fellowship, the MSA Award from the Mineralogical Society of America, the Macelwane Award from the American Geophysical Union, and the Epstein Medal from the European Association of Geochemistry.

—John W. Valley, Citationist

In the News: Honors and Acknowlegements

- **Mary Anderson,** Professor Emerita, long-time editor-in-chief of the journal, *Ground Water*, received a Life Member Award from the National Ground Water Association for special service in the furtherance of the groundwater industry and NGWA. The award was presented December 8 at the 2010 NGWA Ground Water Expo and Annual Meeting in Las Vegas.
- **Cliff Thurber,** faculty, was elected a 2010 Fellow of AGU in Seismology. He was honored, "for fundamental advances in crustal-scale earthquake location and tomography and their joint application to studies of the earthquake cycle, volcanoes, and Earth structure." *(Eos, Dec. 14, 2010)*
- **John Valley,** faculty, was selected as a Fellow of the Geochemical Society and the European Association of Geochemistry. He will present his Geochemical Fellows Talk at the Goldschmidt conference in Prague in August.
- **Huifang Xu,** faculty, has been elected a Fellow of Mineralogical Society of America (MSA) for "significant contributions to the fields of mineralogy, petrology and crystallography."
- **Noriko Kita,** research scientist**,** was elected to be a Fellow of the Meteoritical Society. The award was made at the annual meeting, July 27, 2010 in New York. No more than 0.5% of membership can be elected each year.
- **Chloë Bonamici,** graduate student, was awarded field support from GSA who cited her proposal for "exceptional merit in conception and presentation". One reviewer said, "This is the best written, most clearly contemplated and exciting GSA proposal I have read this year!"
- Graduate students **Liz Percak-Dennett** and **Jason Huberty**, and postdoctoral researcher **Andy Czaja** were named Lewis and Clark Field Scholars in Astrobiology by the American Philosophical Society for their research projects in geomicrobiology and Archean geology.
- Gyosyntec, an international environmental consulting firm with over offices worldwide, has awarded **Kallina Dunkle,** graduate student, a third place cash prize in the Geosyntec student research contest.
- **Chris Gellasch,** graduate student, was awarded the Rocky Mountain Association of Geologists Foundation Veteran's Memorial Scholarship based on his outstanding proposal to that program for support of his PhD research on virus transport to municipal wells.
- A new discovery of a piezoelectrochemical effect by graduate student **Kuang-Sheng Hong** is reported on-line at UW-Madison News: http://www.news.wisc.edu/17818.

The five 2011 recipients of the L'Oreal-UNESCO Prize for Women in Science, including Jill Banfield (see below), are featured in large posters throughout Charles de Gaulle Airport, Paris. *Photo, John Valley, March 2011.*

- **Caitlin Keating-Bitonti**, **Dan Murray** and **Kelsey Winsor** each received a three-year NSF Graduate Student Fellowship.
- **Anthony Pollington,** graduate student, won a cash award from the SEPM Foundation Mobil Travel Grant.
- **David Ullman,** graduate student, has had his NSF Doctoral Dissertation Improvement Grant fully funded: *Determining the Phasing of Southern Laurentide Ice-Sheet Retreat and Deglacial Climate Forcings using Cosmogenic Radionuclide Dating*.
- **Kelsey Winsor,** graduate student, was recognized with an Outstanding Paper Award at the 2009 AGU Fall Meeting. Her presentation was titled: *The Relationship between East Greenland Current Temperatures and Southern Greenland Ice Sheet Runoff during the Last Two Deglaciations*.
- **Jillian F. Banfield** (UW-Madison Professor of Geoscience 1990-2001), a University of California, Berkeley biogeochemist and geomicrobiologist, has received two prestigious awards—the Benjamin Franklin Medal in Earth and Environmental Science and the L'Oréal-UNESCO "For Women in Science" award—for her groundbreaking work on how microbes alter rocks and interact with the natural world. The awards ceremony took place on March 3, 2011, at UNESCO headquarters in Paris.
- **L. Frank Brown (MS 1953, PhD 1955),** Professor Emeritus at the Texas Bureau of Economic Geology, received the AAPG's highest honor, the Sidney Powers Medal. Well known for meticulous stratigrahic analyses in the Gulf Coast region, he also taught at Baylor, and served in many professional service positions.
- **Michele L. Cooke** (UW-Madison Professor of Geological Engineering 1996-1998), Associate Professor of Geomechanics at the University of Massachusetts-Amherst, is a newly elected Fellow of GSA.
- **Darrel J. Henry (BS 1973; MS 1976; PhD 1981),** the Campanile Charities Professor of Geology and Geophysics at Louisiana State University, is a newly elected Fellow of GSA.
- **Kent C. Kirkby (MS 1990; PhD 1994)**, Assistant Professor of Stratigraphy and Sedimentology at the University of Minnesota, is the recipient of the 2009-10 Morse Alumni Award. Kirkby pioneered the use of the Geowall—a 3-D, stereo projection mapping system that is used to help earth science students master the critical skills of visualizing and interpreting spatial relationships.
- **Nyal Niemuth (BS 1977)**, chief mining engineer at the Arizona Department of Mines and Mineral Resources, was awarded a Medal of Merit by the American Mining Hall of Fame in Tucson in December 2010. Niemuth used his knowledge of minerals, the mining industry, and Arizona deposits, to promote mineral development for more than 30 years. Because of an initial curiosity about the glacial erratics in his family's Wisconsin farm field, "the mining world today has an impassioned proponent whose career stands as a positive and wide-ranging influence on the industry." (*Mining Engineering Magazine*)
- **Susan K. Swanson (MS Geology and WRM 1996),** Associate Professor and Chair of Environmental Studies at Beloit College, will hold one of the college's new endowed faculty chairs, the Weeks Chair in Physical and Human Geography.
- **Dave Stephenson** (UW-Madison Professor of Geoscience 1965-1979), current member of our Board of Visitors, received the Geological Society of America's Distinguished Service Award at the GSA Annual Meeting in Denver last fall. Dave's service to GSA includes terms as Chair of the Hydrogeology Division, GSA President, Interim Executive Director, and President of the GSA Foundation. He has concluded his term in that last office and now is embarking on his next career.
- **Lee Trotta (BA 1969)** was elected editor of the Wisconsin Ground Water Association.

Student Awards and Scholarships for 2010

The Wasatch-Uinta Field Camp Scholarships
provided by these funds:
C.F. Schiesser, Herbert & Alice Weeks, Paull Family Undergraduate, and William H. & Virgie Twenhofel
Devon M. Armstrong Wyatt M. Bain
Erik A. Bakko Dylan P. Colon
Nicolas T. Dosch Molly L. Finnegan
Stephen T. Johnson Bradley J. Kuntz
Samantha E. Leone Dylan P. Loss
Patrick Loureiro Lauren L. Meyer
Matthew S. Wessale Spenser C. Zwart

Shell Undergraduate Research Fund Awards
(Fall, 2009) Dylan P. Loss
(Spring, 2010) Wyatt M. Bain
(Spring, 2010) Matthew S. Wessale

Peer Mentor Appreciation Awards
Matthew K. Francsis Hannah L. Hubanks
Lynsey J. Spaeth Matthew Weingarten

The Outstanding Sophomore Award
Alexandra S. Macho

The Lowell R. Laudon Outstanding Junior Scholarships
Hannah L. Hubanks Melissa M. Reusché

The Laurence Dexter Environmental Scholarship
Matthew S. Wessale

The Mack C. Lake Outstanding Senior Scholarships
Matthew K. Francsis
Samuel S. Harms
Stephen T. Johnson
Samantha J. Thompson

The Carl and Val Dutton Scholarship
Natalie M. De Maioribus

The James J. and Dorothy T. Hanks Award in Geophysics
Ninfa L. Bennington

The Stanley A. Tyler Excellence in Teaching Awards
Erin E. Fenlon Scott K. Johnson
MaryRuth Kotelnicki

The Thomas E. Berg Excellence in Teaching Award
Bryn A. Benford Kallina M. Dunkle

The Albert and Alice Weeks Outstanding Research Paper Awards
James Freiheit John M. Hora
Manuel Rodriguez

The ExxonMobil Research Award
Shannon Graham

The BP Research Assistantships
Heather E. Jordan Raiza R. Quintero
Sarah E. Siewert

The Distinguished Undergraduate Student Award
Jessica A. Masterman

The Distinguished Graduate Student Award
Paul R. Riley

At the Spring Awards Banquet...

Clockwise from above:
John Middleton and Margie Chan (Distinguished Alumna) with Bob Dott in the background.

Geocub president Liz Percak-Dennett presiding, wearing her tiara for the very last time.

Grad students Rachel Murphy, Shannon Graham (Geoclub president-elect), and John Schneider.

Carolyn Streiff, Dylan Loss, Reba Heiden, Carolyn Thanig, and Boomer Bain. *Photos, Neal Lord.*

Weeks Lectures and Speakers in 2010

January 29–Joshua Feinberg, University of Minnesota, "Window into Deep Time: Paleomagnetic applications to outstanding questions about the Precambrian Earth"

February 5–Julie Newman, Texas A&M University, College Station, TX, "Fabric and texture superposition in upper mantle peridotites, Red Hills, New Zealand"

February 12–Tim Dixon, University of Miami, NSF MARGINS Program Distinguished Lecturer, "Slow Earthquakes in the Costa Rica Subduction Zone"

February 12–Andrew J. Dugmore, University of Edinburgh, "Well adapted but still extinct: lessons in human ecodynamics from the Viking settlement of the North Atlantic"

February 19–Roger Summons, MIT, "The Cloud Paradigm: Geostable molecules as proxies for surface oxygenation"

February 26–J. F. Gaillard, Northwestern University, "Metals in Aquatic Environments: Speciation and Bioavailability"

March 5–Carrick Eggleston, University of Wyoming, "How can bacteria respire using rocks?"

March 17–Scott Tyler, University of Nevada, Reno, "Distributed Temperature Sensing: A Transformative Technology in Water Resources and Ecology" *and*
"Theory and Application of Distributed Temperature Sensing to Hydrology: Operational Aspects of DTS"

March 19–Chris Pearson, National Geodetic Survey Geodetic Advisor for Illinois, "Development of a tectonic model for deformation in the western US constrained by (mostly) GPS measurements"

April 16–John Craddock, Macalester College, "Deformation in southern Laurentia from 2.7 Ga to 250 Ma" *and*
"Dynamics of the emplacement of the Heart Mountain allochthon at White Mountain: Constraints from calcite twinning strains, anisotropy of magnetic susceptibility, and thermodynamic calculations"

April 30–John Eiler, California Institute of Technology, "RAWRR!—Measuring the body temperatures of the dinosaurs or how to stay awake in Isotope Geochemistry"

May 7–Emily Brodsky, Department of Earth and Planetary Sciences, UC Santa Cruz, "Earthquakes Triggered by Seismic Waves"

August 27–Thomas Hanks, U.S. Geological Survey, "The Travels of Clyde Kluckhohn ('28) and the Photographs of James Hanks ('29), 1927-1928: Repeat Photography, Virtual Repeat Photography, and Earth-Surface Change in the Photographic Era"

September 2–Tim Scheibe, Pacific Northwest National Laboratory, "Quantifying Flow and Reactive Transport in the Heterogeneous Subsurface Environment: From Pores to Porous Media and Facies to Aquifers"

September 7–Daniel Joswiak, Visiting Scholar, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, "Past climate and environmental changes inferred from Asian ice cores"

September 10–Bill Rose, Michigan Tech, "Mapping a 49 year eruption of a basaltic composite cone: Pacaya, Guatemala"

September 17–David Shelly, USGS, "Tremor, slow slip, and earthquakes: Interacting modes of fault slip"

September 24–Jim Ogg, Purdue University, "Late Jurassic Time Scale: Integration of Ammonite Zones, Magnostratigraphy, Astronomical Tuning and Sequence Interpretation for Tethyan, Subboreal and Boreal Realms" *and*
"Russian Black Gold—Petro-geology and Petro-politics"

September 27–Susan Hubbard (Birdsall-Dreiss), Lawrence Berkeley National Laboratory, "Toward X-Ray Vision: Geophysical Signatures of Complex Subsurface Processes"

October 14–Leonard Konikow, USGS, "Groundwater Depletion: A National Assessment and Global Perspective"

October 15–David Rowley, The University of Chicago, "Oceanic Crustal Production, Spreading Rate, and Long-Term Sea Level Variability: What We Can Surmise from the Observable Record"

October 22–Robert Gaines, Pomona College, "Resolving the puzzle of Burgess Shale-type fossil preservation in the Cambrian: new evidence from the Chengjiang drilling project"

November 5–Yarrow Axford, Northwestern University, "Vikings, midges and Holocene lake mud: Late Holocene paleoclimate studies on Iceland" *and*
"Lake sediments from Baffin Island, Canada provide a 200,000-year perspective on recent Arctic change"

November 12–Todd LaMaskin, WGNHS, "100 Million Years of Tectonic Reorganization along a Cordilleran-Type Margin: Detrital Zircon Facies of the Allocthonous Western North American Cordillera"

November 19–Marc Caffee, Purdue University, "Cosmogenic nuclides: production, measurement, and applications"

December 3–John Vidale, University of Washington, "Episodic Tremor and Slip, the Curious Third Wheel of Fault Motion"

Left: Dave Stephenson and Bill Simpkins at GSA. *Photo, Carl Bowser.*
Right: Jean Bahr, Jeff Wilcox, and Chris Lowry at the GSA Badger reception. *Photo, Neal Lord.*

2010 Badger Receptions

Alumni and friends signing the guest book...

AAPG: April 12 – New Orleans

Karen Billingsley
Randy Billingsley
Kate McColgin Bower
Magell Candelaria
Alan Carroll
Meredith Rhodes Carson
Ron Charpentier
Linda Ciriacks
Ken Ciriacks
Tom Doe
Eric Frodesen
Sheri Frodesen
Bret Hampton
Marc Hendrix
Bob Hickman
Liz Hickman
Paul LaPointe
Bob Laudon
Brad Macurda
Norma Macurda
Bill Morgan
Mark Myers
Doug Neese
Shanan Peters
Anthony Pollington
Mike Porter
Amy Ruf
Ann Sarg
Rick Sarg
Scott Thornton
Mary VanDerLoop
Janice VerHoeve
Mark VerHoeve
Keith Winfree

AGU: December 14 – San Francisco

David Alumbaugh
Rick Aster
Ninfa Bennington
Geoff Bohling
Justin Brown
Mike Brudzinski
Jonathon Carter
Ping-Yu Chang
Nestor Cuevas
Paula Doe
Tom Doe
Galoriela Farf
JoAnn Gage
Tom Hanks
Ken Hoffman
Jeremy Hoffmann
Eric Horsman
Joe Kington
Matt Knuth
Matthew Kogle
Hillary Lackey
Jade Star Lackey
Yu-Feng Forrest Lin
Chris Lowry
Richard Manser
Rachel Murphy
Daniel Murray
Summer Ohlendorf
Jeremy Pesicek
Mollie Pettit
Rob Porritt
Charlotte Rowe
Martha Savage
John Schneider
Brad Singer
Michael Smith
Carolyn Streiff
Laura Sumiejski
Ellen Syracuse
Alex Teel
Cliff Thurber
Sarah Titus
Mike Tompkins
David Ullman
Herb Wang
Walter Weinig
Matt Wessale

GSA: November 1 – Denver

Ken Aalto
Charles Andrews
John Attig
Neal Auchter
Lukas Baumgartner
Adam Behlke
John Behrendt
Mike Benedetti
Randy Billingsley
Robert Blodgett
Robert Bodner
Geoff Bohling
Gwen Bohling
Chloë Bonamici
Jody Bourgeois
Carl Bowser
Judy Bowser
Ken Bradbury
Chris Carlson
Alan Carroll
Eric Carson
Liz Cassel
Jack Cheny
Kendra Clark
Michale Cobb
Ian Dalziel
Jim Davis
Sally Davis
James C. Dawson
Bridget Diem
Mary Diman
Kirk Domke
Bob Dott
Cynthia Dott
Peter Drezwiecki
Steve Driese
Cole Edwards
Craig Eisen
Kelly Eisen
Kevin Eisen
Norlene Emerson
David Flöss
Andy Fraass
Jessi Furt
Chris Gellasch
Gary Gianniny
Emily Hernandez Goldstein
Laurel Goodwin
Daniel Hallau
Jonathan Hans
David Hart
Noel Heim
Jonathan Hendricks
Jeff Henrickson
Darrell Henry
Tina Hill
Mindy James
Kelly Jaworski
Rachelle Keknen
Kent Kirkby
Todd LaMaskin
Dale Lambert
Caitlin Lauback
Andy Leaf
Lonnie Leithold
Angela Lexvold
Ben Linzmeier
Neal Lord
Dylan Loss
Chris Lowry
Stephanie Maes
Harmon Maher
Niclole Malandra
Robert Malandra
Cathy Manduca
Lynn Margulis
Pat McLaughlin
Stephen Meyers
Bill Mode
Claudia Mora
Diane Munroe
Jeff Munroe
Marcus Mussey
Christina O'Malley
Chelsea Payne
Victoria Petryshyn
Kelsey Putman
Raiza Quintero
Tammy Rauen
Peter Riemersma
Paul Riley
Greg Roselle
Ashley Russell
Matt Salternen
Maddy Schreiber
Ben Shapiro
Ryan Sharma
Elizabeth Sharman
Brock Shenton
Bob Shuster
Sarah Siewert
Bill Simpkins
Brad Singer
Lynsey Spaeth
Frank Spear
Dave Stephenson
Heidi Stephenson
Bob Sterrett
Sue Swanson
Rob Swift
Joyashish Thakurta
Cliff Thurber
John Valley
Jen Wenner
Jeff Wilcox
Chris Wills
Bill Woessner
Georgia Wolfe

At the GSA GeoBadger reception in Denver–
Left: Steph Maes, Chris Gellasch, and Tammy Rauen. *Photo, Neal Lord.*
Right: Ian Dalziel with Bob, Nancy, and Cynthia Dott. *Photo, Carl Bowser.*

The Archivist's Corner
History of the Hydrogeology Program

by Mary Anderson, David Stephenson, and Jean Bahr

The Hydrogeology Program at the UW-Madison has deep roots in the history of the university. Classic studies in hydrogeology were published during the late 19th and early 20th centuries by **T.C. Chamberlin** (Wisconsin Geological Survey and President of UW), **C.S. Slichter** (UW-Mathematics), and **F.W. King** (UW-Soils).

T.C. Chamberlin

C.S. Slichter

The Hydrogeology Program within the department was started in 1965. The mission of the program was, and still is, to offer a comprehensive curriculum in hydrogeology including an introductory course for upper level undergraduates and beginning graduate students and to train graduate students to solve water management problems.

Since its inception, the program in the department has been strongly focused on field studies in Wisconsin. Notable exceptions were field projects in Montana and Burkina Faso. However, the Wisconsin-based work was structured to provide insights into generic groundwater processes that are applicable regionally, nationally, and sometimes globally. For example, work on Wisconsin's lakes and wetlands have provided important insights into generic groundwater processes and also led to the development of a general software package for simulating lake systems.

Graduates of our program are working around the world.

The Stephenson Era (1965-1974)

David A. Stephenson arrived in the Department in 1965 and developed and taught the introductory course in hydrogeology as well as field and seminar courses. He built a strong program in field hydrogeology, focused on studies in Wisconsin, particularly groundwater-lake systems. He mentored nine PhDs and 17 MS students in the department. Stephenson interacted closely with **David M. Mickelson** (now emeritus) who headed the glacial geology program in the department. Several graduate students who majored in glacial geology have pursued successful careers in hydrogeology. Stephenson also established strong ties with the United States Geological Survey (USGS) and the Wisconsin Geological and Natural History Survey (WGNHS) offices in Madison. He was one of the founding members and Chair (1968-74, 76-79) of the Water Resources Management (WRM) Program in the Institute for Environmental Studies (IES, now the Nelson Institute for Environmental Studies); he mentored over 20 WRM MS students, 15 of whom completed double degrees in the hydrogeology program in the department and WRM. In 1974, Stephenson accepted a 90% appointment with the UW-Extension in Madison and relocated his office outside of Weeks Hall, but he remained active in the hydrogeology program. In 1977, he joined the WGNHS; in 1979, he left the university and the state to pursue a career in water resources consulting. Later he served as President of both the Geological Society of America (GSA) and the American Geological Institute (AGI) and, until recently, was President of the GSA Foundation.

Ed Need (front) is preparing to hit the seismic hammer, Lake Wingra, April 1981. Mary Anderson is in the center of the group. *Photo, Barb Bickford, from the department archives.*

Numerical Modeling Academic and Research Programs

In 1971, the first textbook on numerical modeling of groundwater systems was published by Irwin Remson of Stanford University. During the 1974-75 academic year, **Herbert Wang** (geophysics) taught a groundwater modeling seminar course for seven graduate students in the department, which was one of the first courses of its kind in the nation. In 1975, **Mary P. Anderson** (now emeritus), a student of Remson, joined the department as Stephenson's successor. Anderson and Wang developed a formal modeling course, which they taught together until Anderson took it over as sole instructor. Drawing from this joint teaching experience, they wrote a textbook, *Introduction to Groundwater Modeling: Finite Difference and Finite Element Methods (1982)*, that continues to be used to this day. Anderson continued the tradition of a field program based in Wisconsin and also added a research program in groundwater modeling. Following the tradition established during the Stephenson era, she continued research on groundwater-lake systems, collaborating with **Carl Bowser** (geochemistry, now emeritus) on some of these studies. Several of Bowser's graduate students interacted closely with the hydrogeology program and went on to pursue careers in hydrogeology. A few graduate students who focused in geophysics also interacted closely with the hydrogeology program during this time. Anderson continued to forge ties with the USGS in Madison and the WGNHS, as well as IES. Some of her former students now hold leadership positions in the USGS and WGNHS. She also mentored a number of WRM students, some of whom earned double degrees in hydrogeology and WRM. From 1992 to 1995, she chaired the academic programs in IES. In 1992, she published a textbook on applied groundwater modeling co-authored with **Bill Woessner** (a graduate of the UW-Madison hydrogeology program under Stephenson), who was then and still is Professor of Hydrogeology at the University of Montana, *Applied Groundwater Modeling: Simulation of Flow and Advective Transport*.

Anderson served as chair of the department from 1999 to 2002. In

Left: Graduate students in the field, Nine Springs area, near Madison, 2006. *Photo, Jean Bahr.*

2006, she was elected to the National Academy of Engineering and subsequently received a named professorship from the UW. Anderson retired from the department in July 2009 as the C.S. Slichter Professor. During her 34 years in the department she was major advisor to 18 PhD and 34 MS students.

Hydrogeochemistry

The success of the program and the large number of students who sought admission, as well as the growing international emphasis on contaminant hydrogeology, motivated the department to add a second faculty member in hydrogeology in 1987. **Jean M. Bahr** soon developed a strong teaching and research program in hydrogeochemistry, including field, laboratory, and modeling components. Bahr took over teaching the intro hydrogeology course, co-teaching it several times with Anderson and Wang. She also initiated a popular course in contaminant hydrogeology and revitalized the field methods course. She has led highly successful and popular field courses to Mexico and the Southwestern USA. Her research program emphasizes field research in Wisconsin, including a focus on transport and transformation of groundwater contaminants and groundwater/surface water interactions. Through 2010, Bahr has served as major advisor to nine PhD and 30 research MS students in the department. In addition, she has been the primary advisor to 32 MS students in the WRM Program (which she chaired from 1995-1999).

Wisconsin-based work was structured to provide insights into generic groundwater processes that are applicable regionally, nationally, and sometimes globally.

Bahr was chair of the department from 2005 to 2008. She served as the Birdsall-Dreiss Lecturer (GSA) in 2003 and as President of the Geological Society of America in 2009-2010.

Grad students perform field analysis of water samples collected from multilevels in a wetland near Madison, 2010. *Photo, Jean Bahr.*

Brian Hess with the hydro drill rig, Calumet County, WI, 1998. *Photo, Betty Socha.*

Andy Leaf and Jean Bahr hand augering a hole to install a lysimeter at Unit Well 7 in Madison, 2010. *Photo, Chris Gellasch.*

Collaborations and Funding

In 1987, Anderson, Bahr, and Wang joined the newly formed Geological Engineering (GLE) Program, a joint program between the College of Engineering and the Department of Geology and Geophysics (now Geoscience). They advise both undergraduate and graduate students in GLE, and Bahr and Wang remain affiliated with the program.

Throughout its history, the hydrogeology program has benefited from research and educational collaborations with hydrogeologists from the WGNHS and USGS. As of 2011, there are six affiliated faculty from those organizations (**Bradbury, Gotkowitz, Hart, Hunt, Krabbenhoft,** and **Fienen**) who have formal courtesy appointments in the department and who regularly co-advise graduate students and provide logistical support and funding for student research, as well as part-time employment for some of our students. These professors also give guest lectures and teach special topics courses.

Research funding for the many graduate students trained in the program has come mainly from state agencies as well the State of Wisconsin's Groundwater Coordinating Council. The Hydrogeology Program has also brought in funding from various federal agencies including the USEPA, DOE, and NSF.

In spring 2009, the department voted to hire a successor to Anderson, who retired in July 2009. With this vote, the department affirmed its commitment to maintaining a strong program in hydrogeology at a time when water is increasingly recognized as a critical and vulnerable natural resource. The dean authorized a search during the 2010-2011 academic year for a junior faculty member to start in fall of 2011. ●

Crescendo and Encore
at Eyjafjallajökull, Iceland

by Kurt L. Feigl

« La chance ne sourit qu'aux esprits bien préparés » (*In the fields of observation, chance favors only the prepared mind.*)
—Louis Pasteur, 1854

Pasteur's maxim proved true again in Iceland after years of watching and waiting. Freysteinn Sigmundsson and colleagues, including my group at UW, had been monitoring Eyjafjallajökull for decades, using a combination of satellite radar interferometry (InSAR), GPS surveying, and seismology. Although the volcano had shown intermittent unrest for 18 years before it began to erupt in March 2010, it had not erupted since 1823. On two previous occasions, Freysteinn and his colleagues captured intrusive events, but no eruption. Using InSAR, they measured several decimeters of deformation on the volcanic edifice. By inverting the geodetic data, they inferred that a set of sills at 5 or 6 km depth had increased in volume by roughly twenty million cubic meters during each of two intrusive events: one in 1994 and again in 1999.

Then, in the summer of 2009, Freysteinn noticed a "little bump" of about a centimeter in the GPS time series of relative position. He told me he wanted to keep his eye on it. After working with him for over 15 years, I had learned to trust his intuition. Indeed, he and other folks in Iceland talk about earthquakes, volcanoes, and glaciers the way we talk about the weather. We decided to request more InSAR data over Eyjafjallajökull. Bad news: our "usual" satellite, ENVISAT, was showing its age. Good news: the new TERRASAR-X satellite was delivering useful data. Bad news: one image cost over $250! More bad news: the financial crisis in Iceland had chopped Freysteinn's budget. Good news: I had requested funds to purchase InSAR data as part of my startup package when moving to UW in 2006. I decided to commit $20,000. I told myself I was making a leveraged investment, but I felt as if I were buying a big stack of blue poker chips. We started ordering TERRASAR-X images by the dozen[1].

Just after New Year's Day 2010—when Freysteinn had mistakenly told his family that he was looking forward to a calm year—Eyjafjallajökull started stirring. The rate of deformation and the number of earthquakes began to increase. As the deformation and seismic unrest continued, scientists installed more GPS stations near the volcano (Figure 1). A few weeks later, the instruments detected even more rapid inflation, indicating that magma was moving upwards through the "plumbing" inside the volcano. By the time the volcano began to erupt on March 20th, the volcano's flanks had expanded by more than 18 centimeters as magma intruded into the dike and sill structures, as shown in Figure 2. This first eruption was effusive, producing basaltic lava that rose a hundred meters into the air in a "curtain of fire" and flowed over cliffs in spectacular "lavafalls" (Plate 3).

Surprisingly, the rapid deformation stopped as soon as the eruption began. In many cases, volcanoes deflate as magma flows out of shallow chambers during an eruption. Eyjafjallajökull, however, maintained basically

Fig. 1. Dr. Martin Hensch acquiring GPS data under the ash plume of Eyjafjallajökull volcano. *Photo on May 5, 2010 by Thorsteinn Jonsson.*

Plate 3. Left: Lava forming a curtain of fire during the effusive flank eruption of Eyjafjallajökull. *Photo on 24 March 2010 by Gudrún Sverrisdóttir.*
Top right: Lava flowing over a cliff during the effusive flank eruption of Eyjafjallajökull. *Photo on 1 April 2010 by Sigrún Hreinsdóttir.*
Below, right: Lava flowing over a cliff during the effusive flank eruption of Eyjafjallajökull. *Photo on 26 March 2010 by Rósa Ólafsdóttir.*

the same inflated shape through mid-April, when the first eruption ended.

After a two-day pause, the volcano began to erupt again on April 14th. This time, the lava was trachyandesite. It broke out through a new vent under the ice-capped summit of the mountain (see cover photo). This second eruption exploded as gas escaped from bubbles in the magma, fragmenting the rock into tiny particles of tephra. Aggravating the explosion, steam blew out of the vent as hot lava melted a pathway through the ice in a matter of days. The resulting plume rose high into the atmosphere, disrupting air traffic over Europe for weeks and stranding millions of travelers.

Analyzing the time series of InSAR data proved essential for sorting out the sequence of events. Each interferogram represents the phase shift between two radar images acquired at different times. To analyze the interferograms, I applied the General Inversion of Phase Technique (GIPhT) that I developed and patented with **Cliff Thurber**[2]. By minimizing the misfit between observed and modeled values of wrapped phase, we can estimate the best-fitting parameters in a geophysical model. In this case, the model parameters include the location, dimension, and orientation of two sills. They increased in volume by a total of 49 to 71 million cubic meters. Our paper appeared in *Nature* on November 17, 2010[3].

To improve our understanding of the processes driving volcanic activity, we need to visualize the plumbing inside the volcano. To do so, I requested (on May 7th) and obtained (on May 17th) a RAPID grant from the U.S. National Science Foundation to install broadband seismometers around Eyjafjallajökull. **Peter Sobol** and I flew to Iceland on May 18th as the ash plume began to subside, managing to get three instruments in the ground and working on the last day of the explosive eruption (Figure 4). They collected data for two months. Post-doc **Jeremy Pesicek** is currently analyzing the data using ambient noise tomography in collaboration with Cliff Thurber and USGS scientist Matt Haney.

Why did Eyjafjallajökull erupt when it did? We hypothesize that magmatic intrusions deep within the volcano started the processes leading to the eruption. "It was the meeting of two different magma types, one residing under the summit area, and another in the evolving intrusion, that triggered the explosive eruption," says Freysteinn. To test this hypothesis, I am building an international partnership that includes **Brad Singer**, Cliff Thurber, **Tabrez Ali**, and Jeremy Pesicek, as well as alumnus **Tim Masterlark** (Ph.D. 2000), now an assistant professor at the University of Alabama. To continue monitoring volcanos by InSAR will require a new generation of satellites, such as the DESDynI radar mission.[4] ●

Figure 4. Peter Sobol, UW-Madison, sampling tephra at a seismological station near Eyjafjallajökull. *Photo on May 23, 2010, by Kurt Feigl.*

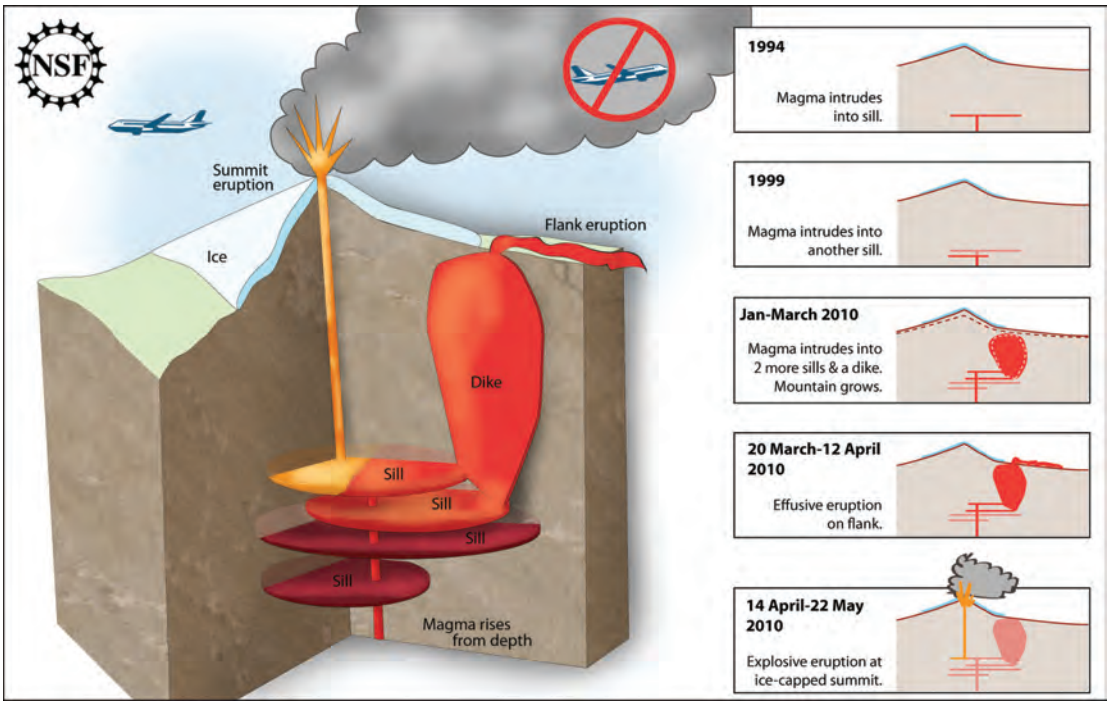


Figure 2. Artist's conception of the plumbing (left) and timing of events (right) at Eyjafjallajökull volcano in Iceland. The volcano consists of interconnected conduits, sills, and dikes that allow magma to rise from deep within the Earth. The first three panels show distinct episodes of magmatic intrusion that caused measurable deformation and seismic events in 1994, 1999, and in the first several months of 2010. No eruptive activity occurred during this interval of unrest. Each intrusive episode inflated a different section of the volcano at approximately 5 km depth (red). The fourth panel illustrates the first eruption, between 20 March and 12 April, 2010, when basaltic magma (orange) erupted onto the flank of the mountain. The fifth panel shows the second eruption, between 14 April and 22 May, when trachyandesite (yellow), erupted explosively at the ice-capped summit (1600 m elevation). The interaction of magma and ice initially increased the explosive activity, generating a plume that rose higher than the 30,000-foot flight level and disrupted air traffic across Europe and the Atlantic for weeks. *Illustration by Zina Deretsky, NSF.*

[1]Satellite radar images were obtained from TerraSAR-X, a satellite mission operated by the German Space Agency (DLR) since 2007.

[2]Feigl, K.L., and C.H. Thurber (2009), A method for modeling radar interferograms without phase unwrapping: application to the M 5 Fawnskin, California earthquake of 1992 December 4, *Geophys. J. Int. 176*, 491-504.

[3]Sigmundsson, F., S. Hreinsdottir, A. Hooper, T. Arnadottir, R. Pedersen, M.J. Roberts, N. Oskarsson, A. Auriac, J. Decriem, P. Einarsson, H. Geirsson, M. Hensch, B.G. Ofeigsson, E. Sturkell, H. Sveinbjornsson and **K.L. Feigl** (2010). "Intrusion triggering of the 2010 Eyjafjallajokull explosive eruption." *Nature 468* (7322): 426-430.

[4]Simons, M. (2011), Budget Cuts and the Next Earthquake: Will Washington save money by nixing high-tech disaster-warning systems?, in *Wall Street Journal*, March 23, 2011.

The Mifflin Meteorite

by Noriko Kita

A little past 10 PM on April 14, 2010, a bright fireball was observed over Madison and throughout Wisconsin, Iowa, and Illinois. The meteor was recorded by an automatic camera on the roof of the Atmospheric Oceanic and Space Science building (AOS) at UW-Madison and by Doppler radar. It turned out to be a shower of meteorites, which we later named "Mifflin" for Mifflin Township, WI, where most of the ~100 stones were recovered. Collectively, Mifflin is only the 14th meteorite ever found in Wisconsin and the 4th recorded as seen. The first piece discovered was brought to the Department for identification, the day after the fall (Fig. 1).

Fig. 1. The Mifflin Meteorite is covered by a thin black fusion crust, which was made during atmospheric entry. The broken surface shows a dark and light colored brecciated texture that may have formed on the surface of the parent asteroid by numerous meteorite impacts. *Photo, John Valley.*

We examined a broken surface by secondary electron microscope (Fig. 2) and determined that the meteorite is an ordinary chondrite. Numerous residents, meteorite collectors, and others swarmed to SW Wisconsin searching for pieces. I joined a trip to the strewn field led by **Rich Slaughter** and **Brooke Norsted** with students and staff from the Department. Richard Jinkins and his family donated samples that fell on their farm for scientific research.

Mike Spicuzza and **John Valley** analyzed oxygen three-isotope ratios (Fig. 3). **Daisuke Nakashima**, **Travis Tenner**, and I used the SEM and Electron Microprobe to examine polished sections made by **Brian Hess**. Scientists from the Smithsonian, University of Chicago, and Field Museum collaborated for mineral and chemical analyses. Our report was accepted by the Meteoritical Society classifying the meteorite as L5 ordinary chondrite and formalizing the name.

The parent asteroid of L chondrites is believed to have been a single asteroid, broken up ~470 Ma by a large meteorite impact. The brecciated texture of all pieces of the Mifflin Meteorite (Fig. 1) may be caused by meteorite impacts at the surface of this asteroid, which is common among other L chondrites. By amazing coincidence, former UW-postdoc, **Philipp Heck,** now Curator of Meteorites at the Field Museum, studied mid-Ordovician (~470 Ma) sediments from Sweden and China and identified tiny chromite grains that originated from L-chondrite meteorites using *in situ* oxygen isotope analysis by WiscSIMS ion microprobe. Heck, *et al.* (2010) published their paper on fossil L-chondrite meteorites in *Geochimica et Cosmochimica Acta* just months before the Mifflin fall. Since April, we have started to investigate two possible craters in Wisconsin, Rock Elm and Glover Bluff, that may have formed when other fragments of this cataclysm struck Earth at ~ 470 Ma.

For additional pictures of the Mifflin Meteorite, see: http://www.geology.wisc.edu/~wiscsims/mifflin_meteorite/

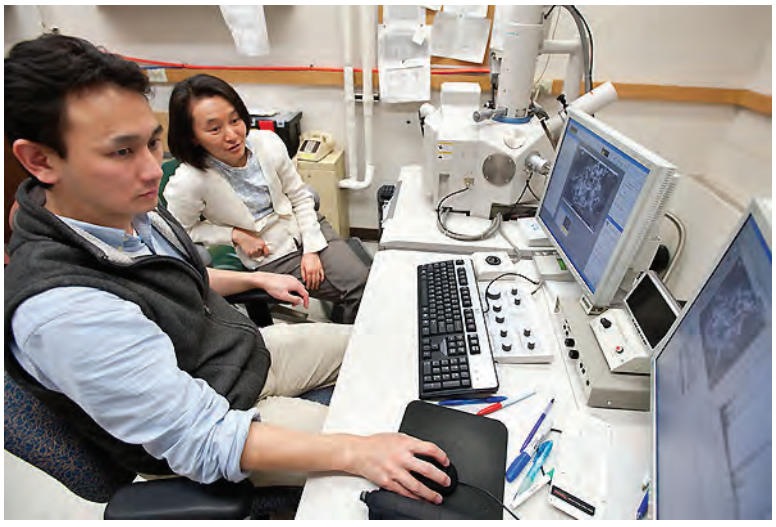


Fig. 2. Takayuki Ushikubo and Noriko Kita looked at the broken surface of the Mifflin meteorite using SEM and X-ray spectrometer. The meteorite consists of olivine, pyroxene, metal and sulfide, typical of chondritic meteorites (April 16, 2010). *Photo, Jeff Miller, UW-Madison.*

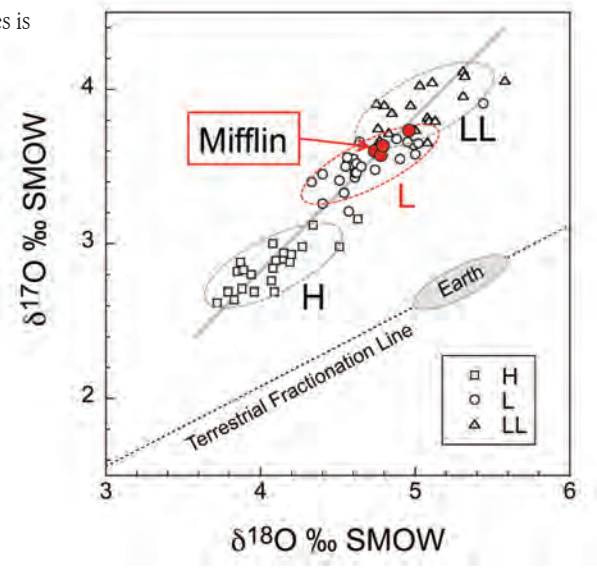
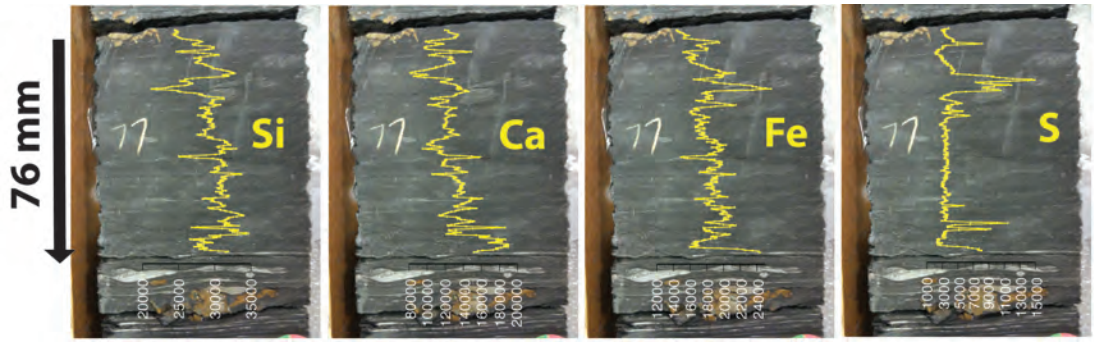


Fig. 3. Oxygen isotope ratios clearly distinguish Type L, LL and H chondrite meteorites from the Earth. Analysis of the Mifflin Meteorite by Mike Spicuzza and John Valley identifies it as Type L, which is confirmed by the chemical composition of olivine.

Refining the geologic time scale

New facility in Weeks Hall



Angus Core Test Scan; 200 microns.

by Stephen R. Meyers

A new Avaatech X-ray Fluorescence (XRF) Core Scanner made a dramatic arrival to the new wing of Weeks Hall this past October.

One of only five such instruments in the United States, the XRF scanning technique enables rapid automated acquisition of continuous elemental profiles (aluminum to uranium), across rock and sediment cores up to 1.8 meters long, at resolutions as fine as 100 microns. The method is non-destructive, and is ~40 times more rapid than conventional geochemical methods (e.g., sample crushing, digestion, and measurement via inductively-coupled plasma-atomic emission spectroscopy).

Of note, the UW-Madison Avaatech Core Scanner is the first in the United States to permit automated 2-D elemental mapping of rock and sediment surfaces. The $350,000 cost of this new instrument came from alumni gifts to the department and the university. The new facility is under the direction of recent faculty hire **Steve Meyers.**

Cyclostratigraphy, paleoclimatology, and biogeochemistry will be subjects of intensive research at the new facility, and the instrumentation will have an important role in the intercalibration of orbital time scales with radioisotopic data. The dating of sedimentary deposits via astrochronology is quickly becoming one of the most important tools for refinement of the geologic time scale (GTS); the entire Neogene is astronomically tuned in GTS 2004, and efforts are now underway to develop a complete astronomically-tuned time scale into the Mesozoic. Accurate quantification of orbital influence on sedimentation is facilitated by continuous high-resolution proxy data that record climate-sensitive lithogenic, biogenic, and authigenic processes. XRF scanning permits the rapid acquisition of such proxy data. The first major NSF-funded project to be supported by the new facility is an effort to develop an integrated astronomical and radioisotopic time scale for the Cretaceous, which involves XRF scanning of cores from the Cretaceous Western Interior Basin (in collaboration with Brad Sageman at Northwestern University), and the acquisition of new Ar/Ar ages (with **Brad Singer**) and U/Pb ages (with Dan Condon at the British Geological Survey) from volcanic ashes in the basin.

Establishment of the new XRF Core Scanning Laboratory at UW-Madison will advance our ability to analyze and interpret the stratigraphic record at very-high resolution and will help harness the full potential of core archives that reside in geologic surveys and private collections.

Special delivery: The XRF Core Scanner is hoisted into its new home in Weeks Hall. *Photos, Steve Meyers.*

Three and a half billion years of life on earth

An excursion through Western Australia

by Liz Percak-Dennett

Five members of the Wisconsin Astrobiology Research Consortium (WARC) spent the better part of September on a field trip to the Pilbara Craton, Fortescue and Hamersley Basins in Western Australia. Graduate students **Liz Percak-Dennett** and **Jason Huberty**, postdoctoral researcher **Andy Czaja** (who were all named Lewis and Clark Field Scholars in Astrobiology by the American Philosophical Society), and professors **Clark Johnson** and **John Valley** participated in an eight-day field trip in Western Australia led by Martin Van Kranendonk of the Geological Survey of Western Australia. The excursion followed presentations from WARC researchers at the 5th International Archean Symposium in Perth, which was also attended by **Professor Huifang Xu**.

The Wisconsin Group with trip leader Martin Van Kranendonk at the Trendall locality in Western Australia observing some outstanding 3.35 Ga stromatolites. Clockwise from upper right: Martin Van Kranendonk, Andy Czaja, John Valley, Liz Percak-Dennett, Clark Johnson, and Jason Huberty.
Photos, John Valley

Immediately after the conference, we loaded into a 4WD off-road bus with 20 other geoscientists and drove up the sun-drenched coastline of Western Australia. By the first night the bustling cityscape of Perth had faded and we arrived on the shore of the Indian Ocean, where turquoise waters and coquina abound. We learned how to set up our swags from our van driver and local Aussie expert "Freckle". The next day brought a once-in-a-lifetime opportunity to snorkel with stromatolites in the high-salinity waters of Shark Bay where we all got an up close look at these modern day relatives of ancient microbial communities which only exist in a few places today.

As the trip progressed, so did the journey back through geologic time. Although the first day was spent with stromatolites and modern microbial mats, these "living fossils" were quickly replaced by true fossils, and the following days allowed careful investigation of Precambrian stromatolites, highlights of which included those from the 1.8 Ga Duck Creek Dolomite, the famous Trendall locality of the 3.35 Ga Strelley Pool Formation, and the 3.48 Ga Dresser Formation at North Pole Dome.

We were also able to visit Marble Bar, the hottest city in Western Australia with a record 38 consecutive days over 100°F. Thankfully it was the cool season as we trekked across the brilliantly red, white and bluish grey banded Marble Bar cherts, as part of a several kilometer hike to witness firsthand the famous Schopf microfossil locality, home to the oldest known putative microfossils imbedded in the 3.46 billion-year-old Apex chert.

Aside from cherts and stromatolites, another key focus during the trip were the banded iron formations (BIFs). WARC researchers have been investigating BIFs for the possible role of biologic processes in forming these laminated sedimentary rocks. We saw many of the numerous and well-preserved Archean BIFs for which Western Australia is renowned including those of the Duck Creek Dolomite (1.8 Ga), and the famous Dales Gorge Member of the Brockman Iron Formation (2.46 to 2.5 Ga) in Karijini National Park, where even a soggy walk to Circular Pool thanks to a spring shower couldn't quell our excitement. Freckle, after attempting to assume control over 26 stubborn geologists trying to set up a tarp in the rain for our camp kitchen, later remarked that if he knew how crazy we geologists were, he would have hired a film crew and had the most popular reality TV show in Australia.

In addition to getting a chance to visit and see some of the most outstanding Archean rocks in the world, the team also got a chance to soak up some local culture, returning to North America with a newfound respect for Australian culinary delicacies, several first-hand accounts of Australian animal sightings, and some linguistic lessons straight from the Australian outback. ●

In addition to seeing fossil stromatolites up close, members of the field excursion were lucky enough to go snorkeling with live stromatolites in Shark Bay, Western Australia. Here John Valley (right) and Jason Huberty are getting ready to embark on some underwater microbial mat viewing in the Indian Ocean.

Jason Huberty at Fortesque Falls, Western Australia, the classic locality for study of the Dales Gorge banded iron formation, which is the topic of Jason's research.

Comprehending the Cretaceous of the Western Interior Seaway

Students in the Field

Sightseeing in Kansas, Colorado, and Utah

by Amalia Doebbert

At the beginning of June, a group of eight, led by **Clay Kelly** and **Eric Williams** embarked on a tour of rocks left behind by the Western Interior Cretaceous Seaway. Over the course of 10 days, we covered ~3000 freeway miles, camped in six different places, and looked at rocks in three states. At our first geological stops, we visited the Niobrara Formation at Castle Rock and Monument Rocks in Kansas (there IS topography there!). Leaving the plains behind us, we stopped to see carbonate mounds at Tepee Buttes near Colorado Springs, where we had our (thankfully) only rattlesnake encounter. While in Colorado, we also checked out the Cenomanian-Turonian Boundary global stratotype section near Pueblo. An overnight stop at Black Canyon of the Gunnison provided us with spectacular views of Precambrian basement in one of the country's best-hidden national parks, followed by a drive through the Mesozoic section at Colorado National Monument and moving on to our final destination in the Book Cliffs of Utah. Having finally arrived, we set up camp at a wonderfully isolated spot on Blue Flat near Emery and set out to explore the classic outcrops of the Ferron Sandstone. Highlights in the Book Cliffs included rotated slump blocks and a hard hike at Muddy Creek, a beautifully preserved transgressive succession at Gentile Wash, and more hummocky cross-stratification than you can shake a stick at. Discussions were focused around accommodation, sediment supply, and stratigraphic architecture in distributary systems. A brief visit to the prehistoric museum in Price, an ammonite-hunting stop in the Mancos Shale, and a short foray back into the Jurassic at an unconformity in the Morrison Formation were also part of our Utah adventures. A night spent at the Little Grand Canyon (think gorgeous canyon, no people) and an impressive panel of petroglyphs and pictographs at Buckhorn Wash wrapped up our time in Utah. A great Mexican dinner in Gunnison, Colorado, provided a perfect conclusion to a great trip before one last night sleeping outdoors and the long drive home.

Geologists on the sunny side with cows at Castle Rock, KS.

Left to right: Amalia Doebbert, Ben Linzmeier, Noel Heim, Clay Kelly, Eric Williams, M'bark Baddouh, Eric Skarman, and Jim Ludois.

Group discussion at Teepee Buttes. Carbonate mounds formed as a result of methane seeps, as evidenced by very low $\delta^{13}C$ values.

Looking at the Bridge Creek Limestone C-T Boundry section, Pueblo Lake, CO. *Photos, Amalia Doebbert.*

New Zealand, 2010

Spectacular geology meets spectacular geophysicists

by Carolyn Streiff

As the highlight of a semester studying the geophysical and geologic structure of New Zealand's Marlborough and Alpine Fault systems in our geophysics seminar, we departed in late March for the land of Frodo from O'Hare International Airport. Five of us started our trip a week early on the North Island, accompanied by **Alan Kobussen** (UW-Madison BS, MS 2005.) After landing in Auckland, we traveled south to tour different features of the Taupo Volcanic Zone. A few of our best stops heading south were Wai-O-Tapu (a hydrothermal park in Rotorua), Lake Taupo, and the Tongariro Alpine Crossing.

After crossing the Cook Strait, we rendezvoused with the rest of the seminar group at Kaikoura, where we also met Kiwi geologists Carolyn Boulton and the legendary Dr. Rick Sibson. Our first full day involved a roadside tour of neotectonics of the active Hope Fault and Conway segments of the Marlborough Fault System. Extending SW from the Hikurangi subduction margin, the topography of this area features excellent examples of deformed fluvial terraces, bad road music, and sheep numbering in the millions. Following this system SW, we came to a pull-apart basin, Hamner Springs, with flights of terraces recording the faulting history. We also crossed the road—with almost complete disregard for our limited travel insurance—to examine the Hope fault outcrop and damage zone. While crossing to the West Coast, we saw the slip surface and 4.5 meter scarp of the 1929 magnitude 7.8 earthquake at Buller Gorge. Once we were on the West Coast, we met up with University of Otago Profs. Virginia Toy and Andrew Gorman at Gaunt Creek, where the Alpine Fault damage zone outcrops. To get to the outcrop, we had to cross the raging "creek", where we almost became one **Ellen** short of a seminar group. On the western front of the Southern Alps, Virginia pointed out quartz veins cross-cutting mylonite foliation and pinch and swell structures at Franz Josef Glacier. **Harold** also pointed out that danger signs at the glacier terminus are meant to be disregarded. Continuing south, the Alpine Fault outcrops again at Hare Mare, where sheets of mylonite thrust westward over Quaternary gravels. Finding the outcrop was easy, but finding the way through the forest for **Rachel** and **John**? Not so much. Crossing back over the Southern Alps on our way to Lakes Wanaka and Hawea, we observed terrace structures, folded quartz veins in a classic metamorphic facies gradient, and **Joe's** sad attempt to jump an electric fence barefoot.

During our stay at Wanaka, we climbed the trail to the Rob Roy glacier (some slower than others after the night before). After stopping at the Benmore Dam to see a mesh structure of faults and fractures that Rick Sibson insists is a "fossilized earthquake swarm," we finished our trip at Mount Cook and the Tasman Glacier. We may have taken away great memories and a wealth of new knowledge, but we left behind **Matt's** emergency rope, multi-purpose screwdriver, and sunglasses. ●

Examining a slip-surface at Gaunt Creek with Professors Virginia Toy and Andrew Gorman.

The group trying to out-pose Mt. Cook. The scenery is almost as beautiful as the geophysicists: Jeremy Pesicek, Cliff Thurber, Alex Teel, Richard Becker, Summer Ohlendorf, Rachel Murphy, Carolyn Streiff, Matt Knuth, Ellen Syracuse, Harold Tobin, Shannon Graham, Joe Kington, and John Schneider.

We stopped at a waterfall on our way back across the Alpine Fault near the Gates of Haast. Matt did his best Indiana Jones impression. *Photos provided by Carolyn Streiff.*

Big Bend 2010! Dinosaurs and diabase in the desert

Undergraduate majors head for the border

by Shanan Peters

Spring break in Weeks Hall means gearing up for the field and the spread of GeoBadgers into the wild, to seek out new rocks in (sometimes strange) new places. This year, under the guidance of **Shanan Peters**, and fearless, indispensable graduate student co-leaders **JoAnn Gage** and **MaryRuth Kotelnicki**, a group of 12 undergraduate students struck out for the Rio Grande and the beautiful desert landscape of Big Bend National Park.

The group left Madison on Friday, March 26 after classes were over, and headed west through Wisconsin. After camping on the drive down, we drove past the Wichitas in Oklahoma early the next day. The sight of Mount Scott, a large Cambrian granitic pluton, was a poignant moment for many of us. Already a year had passed since a group of GeoBadgers stood on top of Mt. Scott, surveying the landscape before them at the start of their spring break '09 adventure (see *Outcrop* last year). After enduring the long drive through Texas, our group arrived in the Chisos Mountains and our reservations at the beautiful Chisos Basin campground, just in time to take in the evening twilight.

The next day, we were all eager to stretch our legs, so we packed our daypacks with water and food and headed up into the mountains, taking advantage of the well-marked trails to find our way to the top of the park. From the high vantage point of Emory Peak, we could see the lay of the land. On the far west side of the park, we could see the dramatic walls of Santa Elena Canyon, which were formed by the Rio Grande's cut through Early Cretaceous carbonates, folded and faulted out of horizontal during the Laramide. To the east we could see the hills over Boquillas Canyon, which is also a canyon in the resistant Cretaceous rocks carved by the Rio Grande. In the more immediate surroundings we could see and hold in our hands the intrusive and extrusive igneous rocks and terrestrial sediments that give Big Bend much of its beauty. It was a perfect start for our trip.

Some of the 2010 crew inspects an unusual rock formation in Big Bend National Park. Is it a tree stump or a stock?

From Chisos Basin, we explored the rest of the park. We first went east, to Rio Grande Village and took in the geology around Boquillas Canyon. Sadly, our planned mapping exercise in the interior, off-road part of the park was then thwarted. Our university minivans were not of sufficient durability to get permission to enter the backcountry, mainly due to recent washouts. So, it was back to the west, where we bought topo sheets and tried an on-the-fly mapping exercise, in somewhat oppressive low elevation desert heat! From there it was back to the river, but on the west side of the park near Cottonwood Canyon, where we were able to see spectacular fluvial sediments in the Rio Grande valley and spectacular structures where the Early Cretaceous carbonates were thrust up and over younger Cretaceous rocks.

After enduring the desert heat, our group of students, **Boomer Bain, Erik Bakko, Brian Boston** (watch out for subway and skunks!), **Angeline Catena, Reba Heiden, Carl Holtan, Michael Hurth, Alex Katsnelson, Rob Malandri, Jim Senn, Marshal Tofte,** and **Matt Wessale** all deserved a little comfort. So it was off to Terlingua and La Kiva for the night! All in all, we saw a large amount of really excellent geology and had a great time. So, once again, it was mission accomplished for our spring break GeoBadgers. ●

Undergrads set up camp.

A dozen students spent spring break in the Rio Grande Valley. *Photos, Shanan Peters.*

Geological Engineering Update

By Craig H. Benson,
Wisconsin Distinguished Professor and Chair of GLE

This has been a banner year for Geological Engineering. The undergraduate program is growing rapidly, the graduate program remains strong, and our industry support has been exceptional.

We anticipate having 48 undergraduates enrolled in Geological Engineering this coming spring semester, which is our highest enrollment in years. We are also becoming more diverse. Women now comprise 41% of our undergraduate student population. We are very pleased to have such an exceptionally bright and diverse group of undergraduate and graduate students. **Sabrina Bradshaw**, the GLE recruiting coordinator, has been a driving force behind our enrollment growth.

Geological Engineering also has a new website and a new web address. Please visit us at www.gle.wisc.edu. Our Geological Engineering Facebook page is also new, and has become exceptionally popular with our younger alumni. The Facebook page is readily accessed through the home page of the new website. **Professor Dante Fratta** and Sabrina Bradshaw deserve the credit for the website and Facebook page.

We also initiated the GLE Industrial Leadership Council (ILC) as a council of our industrial partners who value and hire our highly trained graduate students. Contributions from the ILC have been key resources used to recruit and retain bright students to Geological Engineering. You can learn more about the ILC on our website or by contacting me.

Please stop by for a visit if you are in Madison. We would like to show you the exciting things our students are accomplishing in Geological Engineering. You can reach me at chbenson@wisc.edu or (608) 262-7242. ●

Degrees Awarded, May–December 2010

Ph.D. Degrees—December 2010

Jennie E. Cook, Goodwin, *The Physical, Mechanical, and Structural Effects of Diagenesis in Siliciclastic Rocks*

Paul R. Riley, Tikoff, *Fracture system genesis and organization in the Tuolumne Intrusive Suite, Sierra Nevada Batholith, CA*

Jana M. VanAlstine, Carroll, *An integrated tectono-sedimentary analysis of the Ordos Basin and its sub-basin components through the Triassic and Jurassic*

Colin T. Walling, Carroll, *Stratigraphy and Provenance of Siliciclastic Rocks in the Phosphoria Formation*

Masters Degrees—May 2010

Evan J. Earnest-Heckler, Goodwin, *Quantifying the Rheology of Naturally Deformed, Polyphase Rocks in the Mt. Isa Inlier, Australia*

James M. Ludois, Johnson, *Strontium Isotopes in Banded Iron Formation Carbonates: Disequilibrium with Ancient Seawater*

Rachel A. Murphy, Thurber, *Seismicity and Structure of the Katmai Volcanic Region: Results From a Temporary Seismic Array*

Dayanidi M. Ortiz, Valley, *Mineral Inclusions in Zircons: A Tool for Provenance Analysis of Sedimentary Rocks*

Eva T. Szilvagyi, Johnson, *Geochronology of HP/UHP Metasediments and Further Constraints on Peak Metamorphism and Exhumation Rates, Zermatt-Saas Ophiolite, Western Alps*

Kelsey Winsor, Carlson, *Relationship Between East Greenland Current Warming and Greenland Ice Sheet Retreat During Terminations I and II*

Masters Degrees—August 2010

Erin E. Fenlon, Peters/Geary, *Goldilocks' Bivalves: Evolution on Three Spatiotemporal Scales*

Phillip N. Gopon, Brown, *Sandman Low-Sulfidation Epithermal Gold Deposits, Northern Great Basin, Nevada*

Jason M. Huberty, Xu/Valley, *Crystal orientation effects for analysis of $\delta^{18}O$ in magnetite and hematite by SIMS*

Andrew T. Leaf, Bahr, *Distributed temperature sensing in the Sandstone Aquifer system of Wisconsin: New possibilities for characterizing hydraulic heterogeneity*

Anosua Mukhopadhyay (Dept. of Civil Engineering), Feigl, *Numerical Modeling of Crustal Deformation in South Iceland*

Elizabeth Percak-Dennett, Roden, *Iron Isotope Fractionation During Dissimilatory Iron Reduction in Simulated Archean Seawater*

Masters Degrees—December 2010

Meghan E. Dickoff, Bahr, *Modeling flow and arsenic contamination during aquifer storage and recovery pilot tests in Green Bay, WI*

Scott K. Johnson, Anderson, *Groundwater Nutrient Contribution to Dunes Lake, Door County, Wisconsin*

Summer Ohlendorf, Thurber, *Seismicity and Structure at Okmok Volcano, Alaska*

Katy Smith, Singer, *A geochemical and isotopic perspective on magma evolution 103-25 ka beneath Volcán de Santa Maria-Santiaguito, Guatemala*

Undergraduate Degrees

May 2010

Hassan M. Al-Ismail
Ali A. Alshafai
Brian B. Boston
Angeline M. Catena
Matthew K. Francsis
Kelly A. Hoehn (GLE)
Jessica A. Masterman (Chemistry)
Ciara N. Rahn
Roxanne Riesberg
George X. Rothdrake
Lynsey J. Spaeth
Brett M. Wingfield
Toulor Xiong

August 2010

Hana T. Millen
Spenser C. Zwart

December 2010

Erik A. Bakko
Natalie M. DeMaioribus (English, French)
Samuel S. Harms
Rebecca M. Heiden (GLE)
Brad J. Kuntz
Matthew S. Wessale (GLE)

White Lake, Ontario, April 2010: Undergraduate major Samantha Leone gets instructions for the day's mapping project from Phil Brown. *Photo, Shanan Peters.*

Join us October 1-4, 2011

WHITE LAKE TRIP REUNION

by Phil Brown

Likely there's not a person alive who lives in the Elliot Lake, Blind River, Iron Bridge area of Canada who has NOT seen a UW Geology vehicle driving or parked alongside the road in the White Lake area in late April of every year. Why? This figures to be the 70th year that our department has offered a trip to map a portion of the Huronian rocks of Ontario—a succession containing the best preserved early evidence for continental glaciation in the rock record.

While the course may have been first listed on the books as starting after WWII, at the suggestion of **Con Emmons** (dec), **Bob Gates** (dec) took a group of students to the area prior to the beginning of WWII, in the spring of 1941.

Some 932 students (since 1952) have spent the week at White Lake under the tutelage of Bob Gates, **Carl Bowser, Phil Brown, Lukas Baumgartner,** or **Alan Carroll**. Both Bowser and Gates led the course for 25 years each before ceding the course to younger legs and capable expertise in geologic field mapping. "Neither rain, nor sleet, nor snow," applies equally well to the White Lake area over the many years the course has been offered.

This October (2011), following the department's Board of Visitor's meeting, Phil and Carl plan to lead a visit to the area for past students of the course. Ten members of our present or past BOV are White Lake alumnae/alumni covering the years 1953 **(Mark Emerson)** to 1983 **(Jay Nania)**. The year 1975 was especially productive as present BOV members **Charlie Andrews, Carol McCartney** and **Bill Morgan** all enjoyed the Freys' hospitality during that year. Obviously hundreds more of you are out there and we would love to have representatives from every decade join us for this reunion.

I have more than 80 field notebooks that I would love to return to their rightful owners. I also have scores of your maps that I will have in chronological order and hope I can also reunite with their proper artist. We look forward to some of you joining us on the trip. Even if you can't attend the trip physically we would VERY much like you to share your White Lake memories and impressions with your fellow course alumni. I have already received some great notes including a map created by **Jack Hallberg** in 1963 and a wonderful note from **Sally LaBerge (Scholz)** who was the first woman to go on the trip in 1954.

Top: Thursday night bean banquet, 1941. We do better now. Above: The 2000 class photo at the end of a memorable week. *Photos, department archives.*

Our current thoughts on the trip have one or more vehicles departing from Madison early on Saturday morning October 1st and driving all the way to the field area. I (Phil) would most like to avail ourselves of the traditional housing (cabining?) and facilities (and lack there of) at the White River Lodge, however, I recognize that this may not be practical for all who wish to attend.

There are hotels less than an hour away in Elliot Lake (yes the road is paved) or several nearer small resorts that should still be open for the season. We recognize that a reunion of this sort will be most successful if students from across the decades can spend time together and share stories and memories. Thus I am asking below for replies indicating interest in this event and several options for travel and housing.

Flying to Sault Ste. Marie (Michigan or Ontario) is possible and would then require a rental car for the two-hour trip to the reunion.

Those of you with your own vehicles and a desire to have a saner Saturday drive could of course arrange to arrive (and leave) the area on your own schedule.

We plan a big Sunday camp breakfast and, for those willing and able, a hike—perhaps up to the lunch spot on Bat Lake. For those less inclined to bush whacking, there is an easy hike up the road behind Gary and Hanny's garden to Scarbo Lake and its loons and old mine sites. Or you can hang around the camp and get lessons in solar power and wine making from Gary.

A traditional "Thursday night" feast will follow on Sunday evening with fresh blueberry pie, all washed down with some of the very best local beverages.

Given the length of the drive I hope that some people will want to help me play hooky an extra day and spend time in the area on Monday and have the group disband on Tuesday morning. Another option would be to spend half of Monday doing some roadside geology as we worked our way back to the Trans Canada highway and a late evening return to Madison for those traveling in department vehicles.

So please send along some anecdotes and favorite memories to Phil Brown. Snapshots are welcome.

Now the action items:

[1] Are you interested in seriously considering participating in this reunion Oct. 1-4? If so, how many people?

[2] What level of sleeping accommodations are you willing/able to experience/endure to make this happen?

[3] Would you like to travel in a department vehicle to and fro or find your own way?

[4] How many days can you commit to this pilgrimage to what is still a fabulous piece of geology and department history?

Please reply by July 1, 2011.

We really need to hear from you to make necessary plans for housing and transportation.

CONTACT PHIL BROWN

email: pbrown@geology.wisc.edu
phone: (office) 608-262-5954; (cell) 608-335-8351
U.S. mail: Phil Brown, 1215 W. Dayton St., Madison, WI 53706

Come be part of reliving history!

Alumni News 2010

1930s & 40s

Mary Marks Wilcox, BA 1942
Spoke recently with Mary Diman and John Fournelle. She mentioned that two years ago she and Ray (PhB 1933, PhM 1937, PhD 1941) moved from their long-time home in Lakewood, CO, to a smaller seniors' cottage a couple of miles away. They are happy to have three of their children living in the area. They have several great-grandchildren.

1950s

Lynn A. Yehle, BS 1952; MS 1954
Continued surficial geologic map completion, AK.

DeWitt Bowman, BS 1957
DFBowman@aol.com
I retired as Chief Investment Officer California Public Employees Retirement System in 1994 and served as Interim Treasurer to the Regents, University of California in 2000. I'm currently a trustee of several mutual funds, a REIT, and a Nuclear Decommissioning Trust. Not having worked as a geologist, I remember my experience at UW fondly and find the "aura" intriguing at investment management seminars. I do get back to Madison from California regularly and am astounded at the growth of the "U" and Madison.

1960s

Robert W. (Bob) Newfield, BS 1960
2010 was a good year for me with lots of fun memories, many UW Geology related. I was drafted after graduating in 1960. Dr. Laudon said he could get me into the graduate program instead but I elected to go Navy, opted for flight training, and when I got out in March 1966 I decided to go to work for the airlines and get an MS in oil/rocks at the same time. It was hard to choose between the oil side of Dr. Laudon with his charisma, and the logic side of Bob Gates in mineralogy. I attended a few classes but never finished the graduate degree. My mapping partners of the 1957 UW summer field trip (conducted by Dr. Lew Cline and Dr. Bob Dott) were Jack Howard (MS 1962) and David (Andy) Link (BS, UW; PhD Northwestern). Sometime in the 1960s, Dr. Link, then a retired Marine captain, flew me (it was semi-legal then) the full length of the Grand Canyon and Lake Powell (Glen Canyon) mostly below the rim, in a USN reserve airplane type P2V, full bubble nose. It was the best canyon view you could ever get. In May 2010 I visited with these old "U of W" friends in Houston who are retired but still active in their chosen professions.

Ted Cohen in Antarctica with a mascot and a gravity meter–in the early '60s. *Photo courtesy of Bob Dott.*

Nancy Neal Yeend, BS 1965
I am still mediating. Geology helps with sand/gravel mining and landslide cases.

Theodore J. Cohen, PhD 1966
After retiring from a career in the electronics industry doing contract work for the Defense Department, Ted has taken up writing fiction. He recently published an Antarctic murder mystery trilogy with plots that have significant geological and geophysical aspects. The trilogy titles are *Frozen in Time: Murder at the Bottom of the World, Unfinished Business: Pursuit of an Antarctic Killer,* and *End Game: Irrational Acts, Tragic Consequences*. Also read Bob Dott's comments in Emeritus Faculty News (page 34) for more details about Ted.

Ronald C. Blakey, BS 1967
Received an AAPG Media Award for the significant contribution of his outstanding website with paleogeographic maps of the world. Those maps are much used for illustrations in textbooks, other publications and lectures. Blakey is an Emeritus Professor at Northern Arizona University, Flagstaff, AZ and is well known for his extensive sedimentological and stratigraphic studies of the Late Paleozoic and Mesozoic strata of the Colorado Plateau.

Larry Asmus, BS 1968
Larry Asmus@SBCGlobal.Net
I am retired. We recently welcomed our second grandchild and are expecting a third grandchild in February 2011.

Alan and Wendy Niem, MS 1968; PhD 1971/ BS 1970
aniem@charter.net
wniem@charter.net
Alan and Wendy send their regards.

Nancy Crossfield, BA 1969
(Formerly our Geology-Geophysics librarian.) I'm still bemused at trading limestone for gallstones, working in a medical library instead of a geoscience library. Luckily there's an amateur seismologist on staff to talk to. I loved getting the postcards from the field trip students! What a great way to acknowledge donations and keep in touch!

Lee Trotta, BA 1969
lctrotta53072@yahoo.com
I attended the USGS Water Resources Division retirees reunion in Denver. I published my Geologic Hazard Assessment of the High Speed Rail Route this year and I was elected editor of the Wisconsin Ground Water Association. Family news: My daughter announced her engagement and my son and his wife had a baby boy.

1970s

Robert Winn, PhD 1975
Has finished teaching a second year at the Petroleum Institute in Doha, Qater on the Arabian Peninsula. He formerly was Director of Geoscience at a similar institute in Abu Dabi farther down that Peninsula. Prior to that, he taught in Papua New Guinea. He and Cynthia are truly an international couple.

Tom Holley, MS 1976; PhD 1982 (Physics)
A member of our Board of Visitors, Tom has left his position of geophysicist with Shell to become Director of the University of Houston's petroleum engineering program.

Rick Beauheim, BS 1977; MS 1980
rlbeauheim@gmail.com
I retired from my position as a distinguished member of technical staff at Sandia National Laboratories after nearly 26 years leading the

hydrology program at the Waste Isolation Pilot Plant. My wife and I moved to Grande Junction, CO where I am consulting part-time, primarily for the Canadian and other radioactive waste disposal programs.

Brian C. Ball, BS 1979

brian.ball@arringtonoil.com

I am Exploration Manager for Arrington Oil & Gas Operating LLC in Midland Texas, an active driller in Texas and Arkansas developing both conventional and unconventional resource plays. I'm an active member of the West Texas Geological Society. Recent family trips include collecting fossil fish in Wyoming, opal in Idaho, and sapphires in Montana. We make annual trips to the Tucson Gem and Mineral Shows. My son Adam, a freshman in high school, has started his own fossil, crystal and mineral business.

1980s

Edward Need, MS Geology 1980; MS Water Resources Management 1981

edward.need@cabarrus.k12.nc.us

I am currently finishing up my fourth semester of teaching Earth Science to 9th graders for Cabarrus County Schools (the county northeast of Charlotte, NC). This comes after 21 years of environmental consulting and seven years as the stay-at-home parent. As a "lateral entry" teacher, I've been picking up my education courses during the evenings, weekends, and summers. Faced with the task of trying to engage (entertain?) the early adolescent mind on a subject which is, to the many of them who have little exposure to the outdoors, rather abstract and conceptual, I'm always on the look-out for lesson plans and activities–especially any that involve inquiry or hands-on work that can be done with a class of 30+ highly distractable students but no "lab" facilities... That said, I find this work to be very satisfying and hope to spend a few more years doing it.

Personal/family news: My wife, Linda, continues her long career in the financial services industry (banking, brokerage, insurance); my son, Ryan, is a senior at Clemson University studying materials engineering and planning a career in photovoltaics; and my daughter Emily is a freshman at Elon University leaning toward a physics major/chemistry minor with no specific career plans as yet. A rotator cuff tear in August put my recreational ice hockey on hold, but successful surgery and physical therapy have given me the hope of being back between the pipes by March or April of next year.

Captain Jeff Skiles spoke at the Capitol Square in Madison on Feb. 26, 2011, day 14 of protests against Governor Walker's proposal to effectively end collective bargaining by public employees. Over 80,000 people from all over Wisconsin turned out in a sub 20°F snowstorm, the largest demonstration since 1969. Skiles is a 1984 UW-Madison graduate in Geology and the co-pilot who successfully ditched US Airways Flight 1549 in the Hudson River on Jan. 15, 2009, saving the lives of all 155 passengers. *Photo, John Valley.*

Michael Sweet, BS 1980

MLSweet@swbell.net

After eight years at the ExxonMobil Research Company I've moved to working production geology on fields offshore of Angola. It's a good application of what I've learned doing research on Quaternary deepwater systems.

Marjorie Chan, PhD 1982

Announced that the new Sutton Building at the University of Utah has received an official Gold Leed certification. This new building, financed in large measure by a generous gift from Mrs. Marta Sutton Weeks (daughter-in-law of our own Lewis Weeks), has set a new standard of both environmental responsibility and esthetics not only for the Utah campus but for campus planners everywhere. *(See Bob Dott's citation for Marjorie as Distinguished Alumna on page 5)*

John Mackinney, MS 1986

Mr. Mackinney is Director of Nuclear Policy at the U.S. Department of Homeland Security in Washington, D.C.

Claudia Mora, PhD 1988

Dr. Mora, a member of our Board of Visitors, has been selected for the the position of Earth Systems Observatons (EES-14) Group Leader at Los Alamos National Laboratory (LANL). She is a Fellow and Councilor of the Geological Society of America and currently serves on the NRC Board on Earth Sciences and Resources and the Advisory Committee to the NSF-GEO Directorate.

Jean Morrison, PhD 1988

Has become Provost at Boston University and her husband, **Lawford Anderson, PhD 1975** (and Distinguished Alumnus in 2007) is now Professor of Geology at BU. Both had been members of the faculty at the University of Southern California. Jean recently served on our Department's Board of Visitors.

William (Bill) Sauck, post-doc visiting scholar, 1988-90

My wife Elen succumbed to cancer in April 2009. Last year, thanks to Google, my college sweetheart (whom I had not seen or heard from since 1963) found my email address. I went to Des Moines to see her and we got on so well that we married in June. She had five children and was widowed several years ago. Now I have 16 more grandchildren!

1990s

Madeline Schreiber, MS 1995; PhD 1999

Blaine (husband), Jacob (son—almost 4) and I are doing well in Blacksburg, Virginia. I enjoyed seeing faculty and friends from graduate school at GSA in Denver!

2000s

Daniel Douglass, MS 2000; PhD 2005
dcdouglass@gmail.com
I continue as an instructor at Northeastern University. My wife Amber finished medical school a year and a half ago and is currently in her psychiatry residence at Cambridge Hospital. Leo is a bit over 2 now and is a joy to be around.

Cory Clechenko, MS 2001, and Elizabeth Clechenko, MS 2001; PhD 2006
Cory and Liz report that their daughters Lilly and Helen are now 4 and 2, and that they've added a dog, and three chickens (lots of fresh eggs) to the household. They have visited family and friends in the Northeast, Charleston and Madison. "Life flies along, and we continue to be lucky in all our endeavors."

Jacque Kelly, MS 2006
I am continuing my work on my PhD at the University of Hawaii at Manoa. I study submarine groundwater discharge around O'ahu using infrared remote sensing and stable and radiogenic isotope geochemistry. And Patrick and I are happy to announce the birth of our son, Caleb Patrick Kelly on September 3.

Jennifer Lewis (formerly Nielsen), MS 2006
jlnielsen@matcmadison.edu
I am teaching full time at Madison Area Technical College. I became one of the online teaching fellows at the college beginning in fall 2010. I am continuing to teach earth science and general geology in the online formats and am developing an introductory oceanography course. I was married in May 2010 to my best friend, Ian Lewis. We are now expecting our first child in February 2011!

Penny Lancaster, MS 2007
penelope.lancaster@ucd.ie
Penny was awarded her PhD by the University of Bristol (UK) and is a post-doctoral research fellow at University College Dublin (Ireland). ●

Students in Geoscience 515, Phil Brown's "Principles of Economic Geology," study the composition, structure, occurrence, origin, and economics of ore deposits. *Photo, Mary Diman.*

In Memoriam

Francis A. Petersen, PhB 1947,
of Lakewood CO, died on October 3, 2010, after a short illness. He was born in Eau Claire, WI, attended Colfax High School, Eau Claire Teachers College and graduated from our department with a degree in Earth Science and a minor in math. He was employed by Chevron Oil as a petroleum geologist for 38 years and retired in 1985 as Staff Geologist, Division Geologist, Mid-Continent Divison. He is survived by his wife and daughter, six grandchildren and four great-grandchildren.

Gerald (Jerry) Marrall, BS 1950; MS 1951,
of San Marino CA, died on July 27, 2010. He was a valued geologist for Union Oil, later incorporated as Unocal, and retired in 1991.

John Steuerwald, BS 1951
Died July 10, 2010. A resident of Rhinelander, WI, he was a government and private sector geologist.

Hubert H. Hall, PhD 1952
Died September 29, 2010 in Lawrence, Kansas. "Hub" Hall spent his entire career in the petroleum industry with various divisions of the Standard Oil Company of New Jersey, now ExxonMobil. He began in the Tulsa Research Laboratory and subsequently in exploration around the world, including the southeastern U.S. then in Malaysia, Middle East, North Africa, Ireland and England. These efforts resulted in major discoveries in offshore Malaysia and the North Sea. He retired back to his homeland Kansas in 1989. *(See Morgridge, following).*

Dean L. Morgridge, BS 1952; MS 1955
Died February 15, 2010 in San Luis Obispo, CA. Dean joined the Humble Oil Co. staff in Oregon in 1955, but soon was transferred to Alaska to his delight. He spent most of his thirty eight-year career doing field work exploring for petroleum in that state. He was a member of a multi-company team that discovered the Prudhoe Bay field, North America's largest. Dean retired to San Luis Obispo where he became an avid horticulturist. Poignantly, Dean and Hub Hall (above) were close friends and died within months of each other.

Meredith E. "Buzz" Ostrom, of Madison, passed away on Thursday, Nov. 11, 2010, at the age of 79. A graduate of the University of Illinois, he received BS, MS and PhD degrees in Geology. Buzz was the State Geologist, Director of the Wisconsin Geological and Natural History Survey, and Professor Emeritus, UW-Madison Department of Geoscience. He was a true "naturalist", a man for all seasons with an extremely broad range of knowledge and capabilities, and a compassionate leader who played an active role in community, university, state, and national affairs.

Faculty News—2010

Jean Bahr

Spring of 2010 was the second half of a year-long sabbatical. I devoted much of my time to my duties as GSA President. I attended four regional Section Meetings (held in Baltimore MD, Branson MO, Rapid City SD, and Anaheim CA) between March and May 2010. At all of these meetings I made a particular effort to meet with as many students as possible, both at poster presentations and during mentor events. The intellectual curiosity and enthusiasm of these developing geoscientists gives me confidence in the bright future of our science. At the section meeting in Baltimore, I also participated in a plenary session on Geology and Public Policy and I was able to go on field trips in conjunction with the meetings in Rapid City and Anaheim. The section meetings also gave me a chance to visit with a number of Geobadger alumni.

Another major GSA activity involved finalizing revisions to a position statement on climate change, which was approved by the Council in April. This statement puts GSA on record acknowledging the strengthened scientific evidence for the conclusion that humans are a major factor responsible for recent global warming. As such, it provides a basis for advice from the society and its members to policy makers on mitigation and adaptation strategies designed to address the future impacts of anthropogenic warming.

In the fall semester, **Herb Wang** and I shared teaching of Hydrogeology and of Groundwater Flow Modeling. This co-teaching arrangement facilitated my participation in a GSA Executive Committee retreat and the Geoscience Congressional Visits in September, as well as the Annual meeting in Denver (plus another field trip) in November. In the fall I also participated in the planning seminar for the 2011 Water Resources Management practicum, which is addressing the feasibility of using treated wastewater as a source of artificial recharge in the Madison area.

MS Students **Andy Leaf** and **Meg Dickoff** completed theses during the past year and are now employed in environmental consulting in Seattle and Madison respectively. **Chris Gellasch**, who began as a PhD student in fall of 2009 is studying the potential for preferential flow paths in clastic bedrock aquifers to facilitate transport of viruses to deep municipal wells. **Aaron Pruitt**, a new MS student who started in fall of 2010, is developing a project to explore groundwater-surface water interactions and potential effects of climate change in watersheds of the Chequamegon National Forest.

As I write this summary, we are preparing to interview candidates for a new faculty position in hydrogeology. I am very grateful to our alumni, particularly our Board of Visitors, who helped us make a strong case to the Dean for the importance of hiring a new colleague to maintain this area of department strength. (See the article about the history of the program on page 10.)

Phil Brown

My sabbatical continued during the first half of 2010 and included four weeks in Australia in February and March. A few days in Canberra provided me with an opportunity to analyze some interesting fluid inclusions discovered by **Jason Huberty** during his senior thesis work. After obtaining more baffling data I travelled west to Perth and three weeks devoted to visiting several of the famous iron mining areas of the Hamersley Basin. Unaltered banded iron formation (BIF) contains about 35% iron and is not mined in most parts of the world although this parent rock, known as taconite in North America, has become economic in Minnesota and Michigan due to high steel prices in recent years. In western Australia (and Brazil and South Africa) natural processes have dissolved the chert layers out of large volumes of the BIF leaving ores that contain up to 70% iron—understanding these natural upgrading processes is the thrust of much of the current research with a goal of predicting where as yet undiscovered masses of high-grade iron ore may be located—including northern Michigan and Minnesota. I was able to spend a couple days camping and hiking in Karijini National Park where the main un-enriched iron formations are spectacularly displayed in the walls of the canyons. I would caution visitors that summer in Karijini makes for difficult camping conditions although I had the canyons nearly to myself while hiking!

At the end of May and the beginning of June I spent two weeks in Brazil becoming acquainted with the two large iron mining areas that are producing iron ore that has been naturally upgraded to 55-65% iron. In an interesting symbiotic relationship, deforestation of a large piece of the Amazon rainforest identified as a National Park is being held at bay by the fences and security of the mining company who has leases and mines within the park. In addition to the iron mines I visited Serra Pelada, a fascinating old gold-platinum mine that many of you may be familiar with from a visual standpoint even if you don't recognize the name. Google "Serra Pelada" and see the historical pictures of tens of thousands of workers simultaneously toiling in a large open pit mine.

After returning from Brazil we had a joyous family event as my middle child Peter married Abbey in a "destination wedding" in Puerto Rico. June is apparently not the perfect weather time to be on that island but the wedding itself was certainly memorable and a hike the day before left no doubt about what a rain forest is supposed to be like. Later in the summer I taught a few weeks of Field Camp in Utah, enrollments continue to be strong with 59 total students even though Iowa has withdrawn from the consortium.

My immediate family is well—Jason got engaged to his long time girl friend and together they purchased a house near ours. Peter and Abbey continue to live in Columbus, Ohio. Karin is finishing a two-year MBA and Masters in Sports Management

Lisa Colville, Anders Carlson and Rob Hatfield (Oregon State) approach the inland Greenland Ice Sheet, 2010 (see page 26). *Photo, Kelsey Winsor.*

program at U. Mass while coaching at Amherst. Kris continues to see evolutionary changes in the demographics of the Madison public schools from her vantage as a high school librarian and we continue to keep our fingers crossed that the deepening budget cuts don't close the library.

Anders Carlson

2010 was a good year for the Quaternary group. Former MS student **Libby Obbink's** thesis on deglacial Laurentide Ice Sheet runoff and its effects on climate was published in *Geology*. **Lisa Colville** finished her MS degree right at the end of 2009 and is now teaching at UW-Fox Valley. **Kelsey Winsor** also finished her MS in the spring and is continuing on for a PhD investigating the deglacial history of the Greenland Ice Sheet and the role of ocean warming in driving ice retreat. **Dan Murray** is well on his way to finishing his first paper on the deglacial history of southern Patagonia co-advised with **Brad Singer**. **Dave Ullman** passed his preliminary exams in the fall and is now a dissertator. He is researching the early and late deglacial history of the Laurentide Ice Sheet and its climate forcings. NSF funded our study of Holocene Laurentide Ice Sheet retreat and Dave and I conducted fieldwork in May in Quebec and Labrador. We drove 7000 km in 10 days including the brand new road between Happy Valley and Cartwright, Labrador. Kelsey and I with the help of Lisa also returned to Greenland on NSF and National Geographic funded projects. The group gave presentations at Goldschmidt, AGU, the Arctic Workshop at Winter Park, CO, PALeo SEAlevel Worksop at the University of Bristol, and the Scientific Committee on Antarctic Research Open Science Conference in Buenos Aires for a total of 22 abstracts. Although technically 2011, postdoctoral scholar **Alberto Reyes** joined the Quaternary group working with **Brian Beard** and me on Greenland Ice Sheet extent during interglacial periods.

Alan Carroll

After a long period of rebuilding, the sedimentary geology faculty at Madison have attained a size, energy, and youthfulness not seen in several decades. Somehow I have now become the "old guy", and **Shanan Peters** and **Steve Meyers** are the young Turks who are working vigorously to chart our future direction. In addition, the Wisconsin Geological and Natural History Survey has hired two excellent sedimentary geologists in recent years, **Pat McLaughlin** and **Todd Lamaskin**. Both of them actively participate in the department through collaborative research, teaching, and student advising. A newly emergent strength of the department is quantitative analysis of stratigraphic patterns, ranging from 100 microns to global in scale. We are also becoming a leader in the integration of sedimentary geology with isotope geochemistry and radioisotopic dating, through collaborations with faculty such as **Clark Johnson, Brad Singer, John Valley**, and others.

My students and I continue to conduct research on the ancient lake deposits and on sedimentary provenance. One interesting result of this work has been the discovery that the Eocene Green River Formation lakes received drainage from rivers that reached as far as 1000 km into the adjacent western U.S. cordillera. This view contrasts sharply with previous assumptions of mostly local drainage, and suggests that these lakes represented the topographic low point of the entire Laramide foreland. **Lauren Chetel** and **Amalia Doebbert** both published major papers recently that detail parts of this history. Lauren subsequently departed for Houston to work for BP, joining a growing mafia of Badgers that are poised to eventually take over there!

During my sabbatical year (2009-2010) I began a new book project, provisionally entitled "Geofuels: A Passenger's Guide to Energy from the Earth". The book will explore the many ways in which geology and energy are intertwined, and targets a broad audience of non-scientists. It is to be published by Cambridge University Press, provided I manage to find enough time to actually get it written! In my spare time I continue to fly my homebuilt Vans RV-8 airplane, and over the past few years I've gotten involved in cross-country air racing. Last year I actually won my category in two races and took second in two others, by far my best performances so far. At home I'm struggling to keep up with our 5-year old son Liam, who just began kindergarten. Liam has been up in the airplane, and particularly enjoys turbulence. My wife Wendy (a professor in Engineering) recently took a position as the interim Associate Dean of the Graduate School, which has provided some interesting glimpses into the workings of the university.

Chuck DeMets

Time travelled quickly in 2010. Research papers, grant proposals, travel, and teaching commanded most of my time, although my year was punctuated by some wonderful family trips, too. In early 2010, my graduate student **Shannon Graham** and I spent eleven days working in El Salvador and Guatemala, where we sought locations for future measurements of active faulting and attended a regional GPS workshop. In April, the MORVEL model for the present movements of 25 tectonic plates, my signature work of the past decade, was published in *Geophysical Journal International* and I launched its associated Web site (google MORVEL to find the Web site). After a relaxing summer of research and family travel, I taught three courses during the fall semester and attended a GPS workshop in Mexico. My student Shannon Graham presented initial results from her PhD research at two meetings in the fall. Between my twice-yearly research visits with my Russian collaborator **Serge Merkouriev** and my field programs in Jamaica, El Salvador, Honduras, and the states of Jalisco and Oaxaca in Mexico, my research is keeping me and my student(s) busy. Hopefully, 2011 will hold more of the same.

Anthony Pollington "persuading" some rocks to come back to the lab for ion probe analysis—he is sampling lower Cambrian Sandstones (Mt. Simon) from central Wisconsin, near Stevens Point. *Photo, Ellen Syracuse.*

Kurt Feigl

As the renaissance in geophysics continued in Madison, I was pleased to see **Anosua "Chini" Mukhopadhyay** successfully defend her master's thesis entitled, "Numerical Modeling of Crustal Deformation Associated with the Earthquake Sequence of June 2000 in the South Iceland Seismic Zone Using Finite Element Analysis", in the Department of Civil and Environmental Engineering. Now I am learning more about the subsidence produced by geothermal production on the Reykanes

Peninsula in Iceland from second-year graduate student **Aaron E. Masters**. All three of us have enjoyed working with post-doctoral research associate **S. Tabrez Ali** on finite element modeling. When a snowstorm (and the airlines) prevented Tabrez from traveling to AGU, **Cliff Thurber** generously agreed to give his talk with only one night to prepare. Thanks, Cliff!

After "that volcano in Iceland" began to erupt in March, I traveled there twice: once in May with academic staff member **Peter Sobol** to install seismometers and once in October to help write a paper that made the cover of *Nature*, as described in the accompanying article (see page 12 in this *Outcrop*). Along the way, I learned to pronounce and spell "Eyjafjallajökull", thanks to patient tutoring from my friends Freysteinn Sigmundsson and Páll Einarsson.

John Fournelle

In April, my wife Judi Munaker and I visited Europe, visiting colleagues in Barcelona and then traveling to Magdeburg in Germany in search of my mother's father's family (Koenig). I found that Magdeburg had been heavily bombed in WW2 and most civil documents had been destroyed, but found birth records of my grandfather at a church. I had intended to present a paper at the European Microbeam Society's meeting in late April in Amsterdam, but mother nature intervened in the form of Iceland's Eyjafjallajökull (see cover story). We had a very tight timetable to be back in Madison, and cut our trip short. We were in Paris at the time; a travel agent found a flight in a few days to Philly from Barcelona and so we banked on Barcelona's airport being open then. After an hour in a line at a train station, I found nothing was available. Then in line at Avis, I found a woman who'd just rented a small hatchback and was looking for others to share the cost to Barcelona. Six of us (with a Canadian couple and Norwegian guy) drove from Paris to Barcelona in 12 hours. What a fabulous trip! A sunny day, perfectly blue skies (not a plane in sight). We need to do it at a much more leisurely pace next time. I attended the August Microscopy & Microanalysis meeting in Portland, and gave a talk on microanalysis of difficult to evaluate phases in Al-Mg friction-stir welds (related to PhD research of a student I worked with in material science). A few days later I was present at the birth of my granddaughter Olivia in Madison, born to son Michael and his wife Clarey. In December, I attended the largest AGU meeting ever held in San Francisco (19,000 present), where I co-organized a microanalysis session. I presented a poster there in collaboration with **Charles Geiger** (UW MS, 1981) on problems in the electron probe microanalysis of garnets.

Laurel Goodwin

I will always remember 2010 as the Year of Our New Curriculum. As chair of the committee that worked so hard to develop a plan that was simultaneously rigorous and flexible, I think of the unanimous faculty vote for the proposed curriculum with particular warmth. Lots of hard work followed as we put the pieces of our new program in place. Our colleagues in Geological Engineering joined us in promoting the new curriculum, which provides a specific track for students interested in geophysics and/or engineering geology, facilitating a double major. These joint efforts are paying off; we currently have 84 Geoscience majors, up from 59 last year. We have added three undergraduate advisors to share the load, and it is with some sense of relief that I hand the Chairmanship of the Undergraduate Committee to **Clay Kelly**!

My research group continued to shrink in 2010 as students graduated (what other job measures success by the number of employees who leave?). **Evan Earnest-Heckler**, co-supervised by **Basil Tikoff**, finished his MS thesis in spring. **Jennie Cook** gave a strong defense of her PhD before leaving to join BP in the midst of their eventually successful effort to cap the Macondo well. One of Dr. Cook's papers, describing the systematic changes in permeability accompanying progressive diagenesis of a quartz-cemented quartz arenite, will be published soon in *AAPG Bulletin*, with more structural pieces to follow. MS student **John Schneider** is now racing for the finish line, inspired by the carrot of a job with Chevron. Co-supervisor **Harold Tobin** and I are excited about his results, which show that the grain- and pore-size reduction that accompanies formation of deformation band faults results in an increase in both P and S-wave velocities in sandstones. We plan to extend his work to a wider range of sandstones in the future.

On the new research front, I joined paleoseismologist Kate Scharer in southern California in late summer to initiate an investigation of the structural record of strain rate. This work follows the provocative suggestion that the creeping segment of the San Andreas fault shows different microstructures than a currently locked section that fails with significant earthquakes. Unfortunately, the observations were made in sediments of different grain size, so we don't know whether the signal reflects rheology or faulting speed. We collected samples where faults that formed during big earthquakes cut sediments ranging from clay to gravel. I'll let you know what we find!

Stephen Meyers

2010 was among the most exciting, joyful, and hectic years of my life. I joined the UW Geoscience faculty in January 2010, and in February, my son Teal Alix Meyers was born! Gigi and I are engrossed in figuring out parenting, and our new home of Madison, and we greatly appreciate the warm welcome from the UW Geoscience community.

On the research front, my new office and lab were designed and constructed during 2010. The centerpiece of the lab is an Avaatech XRF Core Scanner (see page 15), and the immediate focus of the facility is a 4-year NSF grant with **Brad Singer** and Brad Sageman (Northwestern), to develop an integrated astrochronologic and radioisotopic timescale for the Cretaceous. Graduate student **Chao Ma** joined us last fall to conduct XRF scanning for the project, and I have been developing new statistical approaches for the intercalibration of astronomical and radioisotopic data (presented at the Annual GSA and AGU meetings). Related to this project, Brad Singer and I co-taught a seminar on chronostratigraphy last fall to bring students (and each other!) up-to-speed on cutting-edge developments in the field.

Also at the Annual GSA meeting, **Shanan Peters** and I presented results from a new study that reveals a 56 Myr rhythm in North American sedimentation throughout the Phanerozoic (in press with EPSL). I am particularly excited about this work, because it represents a new synthesis of emerging macrostratigraphic and cyclostratigraphic methods, a topic that Shanan and I plan to continue to develop, along with **Alan Carroll**, as we seek to push the limits of quantitative stratigraphy. In this regard, I have been working with PhD student **Wasinee Aswasereelert** on the application of cyclostratigraphic methods to evaluate a new macrostratigraphic data set from the Green River Formation.

An additional highlight of 2010 was the acquisition of my first major award from NSF (as a lead-PI), a 3-year grant to evaluate orbital-insolation versus stochastic controls on climate over the past 36 Ma. Initial results spanning the past 5.32 Ma were published in the journal *Paleoceanography*, and Wasinee is now working on extending the analyses into the Paleogene, representing the second portion of her dissertation.

Lastly, my PhD advisee Wes Ingram (UNC-Chapel Hill/Devon Energy) and I published the first chapter of his dissertation on gas hydrates in the Gulf of Mexico (*Marine Geology),* and I started to find my footing in the curriculum, teaching GEOSCI 100 and Geochemistry of Sediments.

Shanan Peters

More than three years have passed since I arrived in Madison, and things are looking up. My research group is becoming quite diverse. **Dave Lovelace** continues to make progress on the Triassic of Wyoming. **Ben Linzmeier** is working with **John Valley** and the Wisc-SIMS to measure fine-scale growth increments in Nautilus in order to constrain daily depth migration, the hope being to apply this new technique to fossil analogues. **Deb Weinstein** is tackling the record of continental sedimentation and mammalian evolution in North America. **Caitlin Keating-Bitonti** is working with **Clay Kelly** and me to better understand paleoceanography and macrostratigraphy during the late Miocene, and she has made great progress towards her Master's degree, which she will finish this spring. Our group had seven talks at GSA in Denver this past fall, and I was pleased with all of them.

As for my own research, I continue to focus on macrostratigraphy, and with the help of **Noel Heim**, we've developed some new research and teaching tools. (http://macrostrat.geology.wisc.edu) State survey geologist Pat McLaughlin and I are also working to combine the large scale syntheses of macrostratigraphy with high resolution basin-scale data. I have also taken on the role of lead P.I. for the Paleobiology Database (http://paleodb.geology.wisc.edu), which is a collaborative effort combining hundreds of paleontologists from all over the world. In short, boredom is not a factor!

An outcrop of the Tunnel City Group in Iowa County Wisconsin with Shanan Peters' Sed/Strat class in the foreground on a November field trip. *Photo, Chris Gellasch.*

Eric Roden

Last year (2010) drew to a close with the publication of a ninth paper involving the geomicrobiology lab. Perhaps the most satisfying of these was the shortest one: a *Nature Geoscience* article describing the results of a many-year effort, which included collaboration within (**Huifang Xu** and **Hiromi Konishi**) and outside the department, to define the potential for metal-reducing bacteria to respire with quinone groups on natural solid-phase organic matter. This process was also shown to accelerate microbial reduction of iron oxides. Together these findings elucidate a novel pathway for extracellular electron flow in soils and sediments. Other highlights included two papers with **Clark Johnson** and **Brian Beard**, together with former graduate student **George "Buddy" Tangalos** and postdoc **Lingling Wu**, on redox-driven Fe isotope fractionation associated with microbial iron oxide reduction; and two with this same group (with postdocs **Adriana Heimann** and **Andy Czaja**) on deciphering the origin of Fe isotope fractionation patterns in Archean Banded Iron Formation. In related work, (graduate student) **Liz Percak-Dennett** submitted a paper from her MS research on iron mineralization and isotope fractionation coupled to microbial reduction of a novel iron oxide/silica coprecipitate that mimics iron oxide phases likely to have been present in Archean and Neoproterozoic marine sediments that were the progenitors of Banded Iron Formations. Assistant research scientist **Evgenya Shelobolina** submitted and is currently revising a *Nature Geoscience* paper that describes for the first time the ability of Fe(II)-oxidizing bacteria to oxide the reduced iron content of the primary mineral biotite, which has important implication for the mechanisms of biotite weathering in nature. With at least a half-dozen other papers submitted or in press at the time of writing this blurb, 2010 was by all accounts a very good year publication-wise for the geomicrobiology lab. In the face of all this writing, was there any time for going to the field? The answer, happily, is yes: Liz Percak-Dennett and I traveled to Switzerland in September to obtain sediment core samples from the Bay of Vidy in Lake Geneva. This is a unique sedimentary environment where input of amorphous iron oxides from a municipal waste treatment plant has led to formation of magnetite, apparently through the activity of dissimilatory iron-reducing bacteria. Liz is analyzing the Fe geochemistry and isotope composition of these core materials in order to test whether patterns of Fe isotope fractionation during generation of biogenic magnetite observed in laboratory experiments can be verified in a modern sediment.

Nita Sahai

This was a gratifying year as many of our group's projects on the Origin and Early Evolution of Life, Bimineralization, and Orthopedic Biomaterials started to come to fruition.

Graduate student **Edward Greiner** is determining whether mineral surface-mediated reactions on carbonaceous chondrites may have promoted the selection of L-amino acids over D-amino acids by biology on Earth.

Former student **Tim Oleson's** work appeared in *Journal of Colloid and Interface Science* where we showed that the earliest pre-biotic "protocells" (lipid membrane vesicles) were likely more stable in contact with hydrophilic, positively-charged mineral surfaces (e.g., corundum) compared to less hydrophilic, negatively-charged minerals (e.g., quartz). Changes in pH or ionic strength also influenced protocell stability. Tim's results are also relevant to approaches for making orthopedic implants more biocompatible.

Once bacterial cells had evolved, what would have caused them to generate the energetically expensive extracellular polymers that form those slimy "biofilms"? Graduate students **Jie Xu** and **Chunxiao Zhu** have fascinating results showing that biofilms shield against the toxicity of specific minerals, and that the extent of toxicity depends on surface charge, nanoparticle size, and generation of oxygen free radicals at mineral surfaces.

Human mesenchymal stem cells (hMSCs) are "pluripotent", with the potential to differentiate into various cell types. A goal of bone tissue-engineering is to design pro-osteogenic implant materials, i.e., soluble scaffold materials that, when seeded with hMSCs, promote differentiation

down the bone-forming cell (osteoblast) lineage, so that a few weeks after orthopedic implant surgery, the implant has dissolved away and is replaced by new bone! A conceptual basis for predicting the pro-osteogenic ability of silicate implant materials would significantly increase the efficiency of developing new materials. Using two polymorphs (β-$CaSiO_3$, pseudowollastonite, and α-$CaSiO_3$, wollastonite), graduate student **Nianli Zhang** has shown in the journal *Biomaterials* that silicate crystal structure, which controls dissolution rate, is a fundamental consideration in the intelligent design of pro-osteogenic bioceramics. Meanwhile, post-doc **Dr. Yang Yang** used Molecular Dynamics simulations and Bioinformatics to investigate the role of Bone Sialoprotein in hydroxyapatite nucleation during bone biomineralization, published in *Langmuir*.

I was also delighted to participate in the NASA Astrobiology Institute's outreach activities at a Mallards' ball-game, and honored to be a Plenary Speaker on "Medical Mineralogy", at the International Mineralogical Association's Annual Meeting in Budapest, Hungary. My presentation drew attention in Hungary's most widely circulated newspaper and I was interviewed on Hungarian T.V. I was also interviewed on National Pubic Radio for the program *To The Best of Our Knowledge*, for my expertise in the Early Evolution of Life.

Along with my group and collaborators, I look forward to another year of exciting findings in 2011.

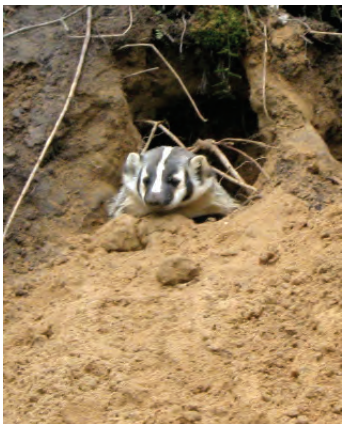
Bradley Singer

2010 was another productive year for my research group that involved also extensive travel to do field work or attend meetings. The year began with fieldwork on Patagonian glaciation with graduate student **Dan Murray** in January. At the Fall AGU meeting in San Francisco, Dan presented new cosmogenic ^{10}Be ages from several of the moraines we mapped and sampled during this campaign. The new 5-collector mass spectrometer arrived and was commissioned in the recently remodeled lab in January thanks to the hard work of **Brian Jicha, Peter Sobol,** and **Bill Unger**. In March, newly arrived NSF post-doc **Heather Cunningham** and I headed for Atitlan Caldera in Guatemala to collect samples for her project to link the pre- and post-caldera rhyolitic and basaltic volcanic history to the origin of the 200 km^3 Los Chocoyos tuff. The Cretaceous Time Scale grant from NSF began and I worked closely with new faculty member **Steve Meyers**, and MS student **Sarah Siewert** on intercalibrating $^{40}Ar/^{39}Ar$, U-Pb, and astrochronology from within upper Cretaceous strata of the Rocky Mountains. I presented results from this project in Beijing, China, Paris, France, Coldigico, Italy, and Steve, Sarah, and I presented them at the Denver GSA, and San Francisco AGU meetings. I was also invited to present results from an ongoing investigation of the Blake events—geomagnetic field excursions that took place between 95 and 120 thousand years ago at a three-day symposium on deep earth processes at the Chinese Academy of Sciences in Beijing in July. The mercury topped 40°C (104°F) during the week in Beijing-one of their hottest on record! I managed to squeeze in a trip to NE Wyoming to collect samples of Cretaceous ash beds from the famous Redbird section of Campanian strata. In December, **Katy Smith** defended her MS thesis on the evolution of magmas that fueled the growth of Santa Maria volcano, Guatemala and we have submitted her thesis to the *Journal of Petrology* for publication. In the midst of all this activity, my group managed to publish nine papers in peer-reviewed journals during 2010.

Clifford Thurber

There are many highlights for me in 2010. In January, I learned that I had been elected a Fellow of AGU. That was a great honor, and it made the December AGU meeting quite special. There was an Honors ceremony and reception Wednesday night and the Honors Banquet Thursday night. The latter might have been even more enjoyable and relaxing if I did not have to give a talk at 10:20 the next morning! Probably the most memorable experience this year was a field trip to New Zealand's South Island that I led with **Harold Tobin**. With nine grad students from geophysics and structural geology and two geophysics post-docs, we explored the major tectonic features of the South Island, including spectacular fault zone exposures (see page 18). Another travel highlight was a trip to attend the Meeting of the Americas in Foz de Iguassu, Brazil, in August. My wife Judy traveled with me and we added on memorable side trips to the Amazon and the Pantanal.

My research group grew in size this year, with post-doc **Emily Montgomery-Brown** joining us in the spring, new graduate student **Helena Menendez** starting graduate work in the fall, and undergrads **Dana Peterson** and **Matt Wessale** working on independent research projects, with Matt presenting his results at the December AGU meeting and Dana assisting with my own AGU presentation. There were quite a few milestones for my current grad students. **Rachel Murphy** and **Summer Ohlendorf** defended their MS theses, **Ninfa Bennington** defended her PhD thesis, and **Alex Teel** is on the verge of completing his PhD prospectus. In other news, post-docs **Jeremy Pesicek** and **Ellen Syracuse** had papers appear in the same issue of the *Journal of Geophysical Research* this fall, Ellen's proposal to extend her previous seismic imaging of the subduction zone in Costa Rica and Nicaragua to El Salvador and Guatemala was funded by the NSF MARGINS program, and Jeremy and Ninfa had papers appear in *Geophysical Journal International* and *Pure and Applied Geophysics*, respectively. Over the summer, **Bill Unger** supervised grad student



Photo, Matt Kogle.

If you want to see a badger, just come along with Matt.

During the summer of 2010 **Kelly Hoehn** (recent GLE and geoscience graduate) and **Matt Kogle**, grad student in geophysics, were completing field work associated with EarthScope's USArray for **Cliff Thurber** when they came upon Wisconsin badgers in the wild. The project involved finding sites to house 21 seismic stations across the state of Wisconsin on a 75 km grid system. They drove many hundreds of miles on rural roads across the state locating landowners who were interested in housing a station for a two-year period. While on a country road northeast of Stevens Point, they saw three badgers run into a den. They stopped and observed one of the badgers for a few minutes and took photos. Matt assumes that the two that scurried back into the den were young while their mother (?) stood guard or was just curious.

Below is a link to a university news article about the EarthScope project.

http://www.news.wisc.edu/18262

Matt Kogle and recent grad **Kelly Hoehn** in the identification of sites in southern and central Wisconsin for 21 seismic stations of USArray (part of the EarthScope program, supported by NSF). Installation will take place in 2011. Summer and Rachel spent two weeks in Katmai National Park participating in the International Volcanological Field School. In September, Jeremy spent time on a ship deploying ocean-bottom seismometers around Loihi Seamount, off the south coast of Hawaii, and at about the same time, Ellen and **Neal Lord** went to the Christchurch area of New Zealand to deploy seismic instruments following the magnitude 7.1 earthquake there.

I have five months left in my term as department chair (but who's counting). It has been a challenging time to be chair. Much has been accomplished, but some important tasks remain to be completed. I can then look forward to an overdue sabbatical in 2011-2012.

Basil Tikoff

2009 Here is a quick "highlight" tour of my 2010.

Paul Riley successfully defended his PhD dissertation in the fall. Paul studied methods of quantifying fracture development in the Sierra Nevada mountains of California, and did a superb job. He somehow managed to also work on articles about fractures in Tunisia and the tectonic development of Long Valley caldera. He is headed to Houston in early 2011 to work in the oil industry.

The structural geology research group was joined by **Richard Becker, Nicole Braudy**, and **Jue Wang**. Richard worked with **David Mickelson** for a Masters degree in glacial geology, but is now working at combining structural geology and geomorphology for a PhD project in the Sierra Nevada mountains (partially building off Paul Riley's work). Nicole Braudy will work in western Idaho on a large EarthScope project there. Jue Wang will study faults in the Geoscience Visualization Center, which were developed in an experimental basin at the University of Minnesota.

Bryn Benford continues to work on her project on the tectonics of Jamaica, in addition to being the head TA in the department for the year. She is making sense of a pretty complicated (and jungle-rich) area—and a pattern is beginning to emerge! **Nico Garibaldi** put in a field season in El Salvador, which required eating a lot of papusas (if you don't know what those are, you are missing out!). **Seth Kruckenberg**, an NSF Postdoctoral Fellow, continues to work on the Twin Sisters ultramafic complex and amaze all of us with his drafting ability.

Matt Francsis finished a very nice senior project on faulting in the Twin Sisters ultramafic complex, with a lot of assistance from Seth Kruckenberg. Matt is now in graduate school at Virginia Tech.

I helped write the EarthScope Science Plan for the next 10 years. That was a lot of work, but I think that the result is pretty good.

I am still working to develop general science classes for education majors (students who will go on to be teachers), and am attempting to get university funding/buy-in. A very nice surprise was that we received an independent assessment of the "Ways of Knowing in Science" (co-taught with Nancy Ruggeri; School of Education), in the Integrated Liberal Studies Program, which indicated that students significantly improved their critical thinking skills. It is always nice to get positive reinforcement.

Last, but certainly not least, Oliver survived and is growing. By the end of the year, he was speaking full sentences, counting to 100, and just beginning to read. Not bad for a two year old. Now, if we could only get him to sleep a little more.

Best wishes to all of you for a happy and healthy 2011.

John Valley

On April 14, Wisconsin was treated to a massive fireball and rocks falling from the sky! What more could a petrologist ask? This led to intense public interest, swarms of collectors to SW Wisconsin (some tried to come from Europe, but were prevented by a sympathetic volcano in Iceland, see cover story), two exhibits of recent falls by the Geology Museum, and an interesting research project (see Mifflin Meteorite on page 14). We are looking with renewed interest at two putative Ordovician meteorite craters in Wisconsin, that may relate to the recent fall. Since April, members of the department have examined many hundreds of possible meteorites. For me, this included a couple of real ones plus lots of clinker, BIF, ordinary gabbro, and a piece of what I think was once a lawn-mower blade.

In March, lecture invitations gave me opportunity to visit with former UW post-doc, **Ilya Bindeman** (Univ. of Oregon) and former UW faculty, **Jill Banfield** (UC-Berkeley). Jill and Perry have bought land in the hills near Napa Valley and built a dream-house that's off the grid and uses solar power. Another invitation, in September to give the Plenary lecture at the 5th Intl. Archean Symposium in Perth Australia, was followed by a wonderful trip to the Pilbara craton to examine the oldest fossil evidence for life (see page 16). Six geo-badgers attended IAS, including grad. students, **Jason Huberty** and **Liz Percak-Dennett**. Jason's report on the Dales Gorge BIF is the first to show micron-scale textures and correlated oxygen isotope zoning (WiscSIMS), proving a diagenetic history, and ending decades of speculation about marine precipitation of magnetite.

For vacation, last May, Andrée and I walked 8 days with friends across the Pyrenees along a portion of the old pilgrimage route from France to San Juan de Compostela, Spain. This was the invasion route of Charlemagne and Napoleon. I recommend it; it's packed with history, scenery, and good food (GR65 in the French trail system). In July, Andrée and I attended our oldest son, Matthew's, PhD defense at Columbia (neurobiology). Matt, with his wife Claire, is now in Paris at the Pasteur Inst. You can expect to hear more about Paris next year.

Herb Wang

January began with teaching rock mechanics, which was offered for many years by **Professor Bezalel Haimson** in geological engineering and taught the last couple of years by **Dave Hart** (MS 1994; PhD 2000). Professor Haimson's rock mechanics lab was moved into the basement of Weeks Hall the previous summer. In January **Matthew Kogle** (MS 2011) untangled things and **Neal Lord** got the servosystems up and

Gordon Medaris gives an impromptu lecture on marbles in the Seiad complex, California, Gordon's PhD area. *Photo, Basil Tikoff.*

Neal Lord checks distributed temperature data at 4100-ft depth level in the Sanford Laboratory at the Homestake Mine (yes, there is internet down there). *Photo, Herb Wang.*

running. **JoAnn Gage** (PhD 2012), who took the course from Dave Hart, provided continuity as the teaching assistant. In February, Neal and **Andy Leaf** (MS 2010) helped me install 600-meters of Distributed Temperature Sensing (DTS) cable in a drift at the 4100-ft depth level in the Sanford Laboratory at the Homestake Mine in Lead, S.D.

I spent the early part of June in the Lower Ninth Ward of New Orleans for the fourth summer with a multidisciplinary group of nine students, about half grad and half undergrad. Professor Lydia Zepeda from the School of Human Ecology and Dr. Quentin Carpenter from the Nelson Institute were co-instructors. Scholarships were available to defray the cost of lodging and transportation through a generous donation from George and Jane Shinners of Antigo. George approved my travel expenses when I was a summer intern at the Corning Glass Works in 1966, the summer I graduated from UW. How I reconnected with them is a bit too long to write out here, but suffice it to say that our lives as Badgers intersect or are tangent in many ways.

Other travels in the summer included being a reviewer at the Lawrence Livermore National Laboratory, attending the American Rock Mechanics Association meeting in Salt Lake City, working with Spearfish, SD high school physics teacher, Steve Gabriel, who is monitoring the DTS setup in Homestake, and having our fiber-optic grant reviewed by a panel at NSF. The trip to the Black Hills included a special tour on the arm of the Crazy Horse Memorial with **Walter Weinig** (BS 1983) and his family. Walter is with the Denver office of Golder Associates, which has done much of the geoengineering work for the deep underground cavities for physics research at the Homestake Mine.

In the fall **Jean Bahr** and I co-taught the hydrogeology and groundwater modeling courses. This arrangement allowed me to spend the month of October at various meetings—a geothermal workshop in Reykjavik, an invited talk at GeoDarmstadt, a gathering of German geological societies (theme was Geowissenschaften sichern Zukunft or Geosciences Secure the Future), a German Science Foundation review panel for the International Continental Scientific Drilling Program (ICDP) in Berlin, and finally a keynote talk at the International Society of Rock Mechanics (ISRM) meeting in New Delhi. The usual closing event of the year was the San Francisco AGU meeting where we could get together with our collaborators on the Homestake project, including Mary MacLaughlin of Montana Tech and **"Tomo" Tokunaga** (post-doc 1996) of the University of Tokyo. Although Mary is a "Gopher" by undergraduate degree, she hails from Eau Claire and cheers the Packers. AGU is enjoyable also for the chance to reconnect with alums at the reception in the Sir Francis Drake hotel.

Huifang Xu

Graduate student **Kuang-Sheng Hong** (PhD, 2010) was graduated in the summer of 2010. Kuang's thesis is about his newly discovered *Piezoelectrochemical* effect, a phenomenon of converting mechanical energy into chemical energy directly. His study provides a simple and cost-effective technology for direct water splitting that may generate hydrogen by scavenging waste energy such as noise or stray vibrations from the environment. **Fangfu Zhang** (co-advised by **Eric Roden**) has published a new empirical curve for determining compositions of Ca-Mg carbonate minerals in the calcite disordered dolomite series. He is tackling "the dolomite problem" that has puzzled geologists for decades. Graduate student **Tina Hill** has discovered natural keatite phase (a silica phase, or silica-k) as precipitates in pyroxene of an ultra-high-pressure metamorphic rock. Although the keatite name has been used in many mineralogy textbooks, natural keatite was not reported before. **Jason Huberty** (co-advised by **John Valley**) has investigated micro-structures and micro mineral phases in banded iron formations (BIFs) from Hamersley basin of Western Australia. His new findings will shed new light to the sedimentation environments in the early Earth. **Mo Zhou** has investigated roles of sheet silicate minerals like mica and chlorite in controlling nucleation and growth of carbonate minerals. Her results clearly show that biotite surface can enhance calcite precipitation and regulate orientations of calcite crystals. **Zhizhang Shen** (co-advised by **Phil Brown**) has investigated dolomitization process using Wisconsin dolomite and partially dolomitized limestone to reveal evolutions of crystal orientations, shapes, and compositions of dolomite and replaced calcite crystals. Visiting graduate student **Zhongwei Wu** has been working on gold and silver nano-crystals associated with sulfide minerals from modern black chimneys in order to understand mechanism for enriching the nano-crystals. Postdoc, **Hun-Bok Jung** (co-supervised by **Eric Roden**) has discovered interesting behavior of uranium in nanoporous environments that are common in soils and groundwater aquifers. His results clearly show that a nanopore surface can immobilize uranium and inhibit its reduction. **Hiromi Konishi** has studied defects and nano-minerals like ferrihydrite (very common and important in earth surface environment) using our aberration-corrected electron microscope. His new chemical images (better than 0.1 nm resolution!) provide real pictures of ferrihydrite structure that has been disputed for decades.

I have many things to be thankful for. I was tenured in the spring of 2010. I appreciate my mentor committee members and colleagues for their support and encouragement. I was also elected as a Fellow of the Mineralogical Society of America. One book chapter of *"Role of microorganisms in mineral precipitates associated with deep sea methane seeps"* has been published (in *Geomicrobiology*, Springer). Our recent publication in *American Mineralogist* about manganese dendrite may be of broad interest. All studied dendrites contain no pyrolusite (MnO_2), but other Mn-oxide nano-minerals. I am still excited about studying mineral reactions at the atomic scale, and applying the results to explain interesting geological phenomena like generation and disappearance of banded iron formations in early Earth, and dolomite abundance oscillations during the Phanerozoic. ●

Emeritus Faculty News—2010

Mary Anderson

2010 was a year of endings and beginnings. In December, I ended my 9 year term as editor-in-chief of the journal *Ground Water*. It was a rewarding experience and I shall miss some aspects of the job. I attended my last editor's meeting at the National Ground Water Association's (NGWA) EXPO (in Las Vegas) where I was honored by a Life Member Award. While there I also had a good chat with former UW professor and BOV member **Dave Stephenson**. **Scott Johnson** finished the MS in December (co-advised by **Ken Bradbury**, WGNHS); Scott is currently teaching part time at MATC. Former PhD student **Chris Lowry** started as assistant professor at the University at Buffalo after a two year post-doc with **Professor Steve Loheide** (Civil and Environmental Engineering, UW-Madison). I continue to co-advise **Kallina Dunkle** for the PhD (with **Dave Hart**, WGNHS). Additionally, committee work with the National Academy of Engineering, GSA and NGWA, as well as three book projects will keep me busy for awhile!

In October, hydrobadger **Chunmiao Zheng** was in Madison to a give a lecture sponsored by UW-Madison's China Initiative. In November, Charles and I went back to Japan (my 5th trip there) for 16 days; I gave one of the keynote presentations at a conference in Kyoto. We re-connected with Professors **Fumi Sugita** and **Kuni Miyaoka**, both of whom were visiting scholars in our department. We rented a small house in Kyoto (recommended by UW alum **Tom Doe**) and travelled to "old Japan", including the fishing village of Wajima, and the castle towns of Kanazawa, Matsue, Hagi, and Tsuwano. Lots of interesting people, food, sights, and memorable experiences, not least of which was the conference.

In January 2010, Charles and I started a new chapter of our lives by buying a vacation house just south of Baileys Harbor, Door County, NE Wisconsin. We have been visiting Door County for over 30 years and love that part of Wisconsin. We will maintain our Madison house as our principal residence and spend at least several days each month up north . . .even during the winter. In April, we finally had our 1950s style kitchen in Madison re-modeled. Throughout the year we enjoyed lots of theater and opera, locally, and also in Des Moines, the Twin Cities, Chicago, and Stratford, Ontario. I continue in aikido (a Japanese martial art) and Charles continues his volunteer work with a support group for the UW-Madison opera.

Charles R. Bentley

The highlight of my year came right at the beginning—in January I racked up the seventh consecutive decade during which I've been to Antarctica at least once. The reason again was to visit the WAIS Divide site in central West Antarctica where our Ice Drilling Design and Operations (IDDO) (formerly Ice Coring and Drilling Services (ICDS) group was completing its third of a planned four seasons of deep ice-core drilling. The site is over the Byrd Subglacial Basin on ice 3450 m thick. Going there was like old home week for me, because it is close to the Bentley Subglacial Trench.

The year was pretty much taken up with routine activities (meetings, report writing—exhilarating stuff like that), but there was one item of interest. Andy Smith and his group from the British Antarctic Survey reoccupied one of the sites from the UW 1960-61 Byrd-Bellingshausen Sea traverse that turns out to be on Pine Island Glacier, whose downstream portion is hyperactive these days. He found no change in ice thickness over the nearly 50-year time interval, indicating that the active thinning downstream does not (yet?) extend to the upper part of the glacier. Of straight geologic interest is that the surface height (measured by gravity because of the huge potential errors in the old aneroid altimetry) has dropped by several tens of meters, implying bed erosion at a rate upwards of a meter per year! It's great fun seeing the old data used again.

A personal high point was watching (in part literally, through Skype) my one and only grandchild grow—he had his first birthday in September. He lives in Durham, England, where his father (my son) Alex is on the university faculty.

The year ended in a surprising way. Having passed my Antarctic physical I was ready to go south again but I was turned down on the grounds that there wasn't room for me! I never thought I would live to see the day that Antarctica was so overpopulated that I couldn't visit it!

Carl Bowser

Having missed last year's Outcrop news, it's appropriate to fill in some gaps in my activities the past two years. Outside of a continuing keen interest in all things geological, my recent exploits and accomplishments are mainly in the field of my new "career" since retirement, photography. Publications have been been replaced by the processes of printing, matting, framing, and hanging photographs in local shows. We're regular visitors to Santa Fe and in May of 2010, I led a group of seven other photographers through country that inspires my work and that lies in the heart of Georgia O'Keeffe artistic inspiration. We spent several days at Ghost Ranch, the spot I first visited in the mid 60's to oversee the work of **Frank Stapor's** (MS 1967) thesis on the Todilto Formation.

This year our Center for Photography (CPM) celebrated Photo Midwest 2010, and I had several shows in connection with the month long program. They include "Venetian Fragments" at the Lowell Center on Campus, "Leaning Against Adobe Walls of Old" a joint exhibit with my colleague Don Mendenhall shown at the Capitol Lakes gallery and café, a joint exhibit with members of the "Signature Style Group" at the Pinney Branch Library (Title: "Signature Style"), and finally a group showing of the May excursion to Santa Fe at Pasqual's Restaurant in Hilldale (entitled: "Georgia on our Minds"). A busy time!

Judy and I attended GSA in Denver this year, in part to see the GSA Distinguished Service Award presented to **Dave Stephenson**, and to see the many old friends we have come to know in my 50+ years with GSA. Regular trips to Tempe, Omaha, Puerto Peñasco, Mexico, Santa Fe, and the lakes district of northern Wisconsin keep us active when not at home. A Mediterranean cruise around Italy, Monaco, Greece, and Turkey in May of 2009 kept us and my camera very busy.

After 47 years in Madison we have decided to relocate in Tucson, AZ. A year ago we spent two months in Arizona and New Mexico deciding where to live (candidates included: Santa Fe, Phoenix, Sedona, and Tucson). Thanks to the persuasive skills of **Ken** and **Linda Ciriacks**, Tucson emerged the winner. This last Christmas season we spent several days shopping for a home, and successfully bid on one this January. It's a dream home, closer to family, and I'm anxious to link with colleagues in the geology department at U of A. The mix of climate, fascinating geology, photographic community, and the University of Arizona were too tempting. Of course, we'll miss Madison, but the new home was chosen to have ample guest room, and we'll expect a call if any of our friends and colleagues are in town.

David L. Clark

Work on a better definition of the major Paleozoic unconformity in the Central Wasatch Mountains of Utah is progressing. We have determined that the same species of Late Devonian conodonts occur in the rocks both immediately above and below the interval that for more than 50 years has been regarded as a Late Devonian-Middle Cambrian unconformity. In addition, the rocks for at least two meters below the bogus unconformity contain conodont fragments of undetermined older Paleozoic age. Physical evidence for the unconformity within the thick dolomite sequence is not obvious, but clearly Cambrian rocks do not occur immediately below the traditional level of the unconformity. Because the first part of the study sampled the dolomites (at 10-15 cm intervals) for only a few meters below the supposed unconformity, additional close spaced sampling will be necessary in order to establish the location and age of the major Paleozoic unconformity in the Rock Canyon area of the Central Wasatch Mountains.

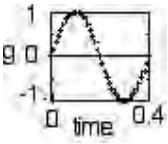
Louise and I are finding it difficult to ignore the indignities of old age, but because of our semi-active cultural life, frequent visits with children and grandchildren, plus occasional notes and visits from former grad students and other Wisconsin friends, we feel as though we are still part of what is going on in one part of the world. Also, if there is continued departmental funding for the various projects of emeriti professors, identification and definition of the Paleozoic unconformity eventually may be successful.

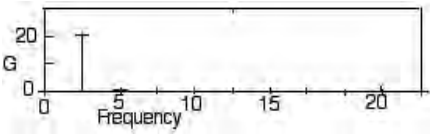
C.S. Clay

Last year, I reencountered a short-cut error in the literature. In the middle of the night, the rejection of our paper on climate history hit me hard. The reviewer said that **Cliff Thurber** and I had used Fourier integrals instead of the fft (fast fourier transform). I first encountered this misconception years ago.

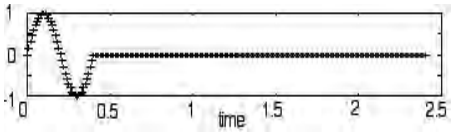
My story follows: In the 1960's while I was at Columbia University, I was invited to IBM for an introduction to the fft. In those days, computers were hard-wired and the inputs were a stack of punch cards. So what is the fft?

The IBM gang assumed the signal g, of duration T, was a term in the series $g(t) = \sum [g(t + m T\}]$ as m goes from - to + infinity, and the spectrum of g is G = fft(g). For example, we let g be one cycle of a sine wave and then use the fft(g) to get G

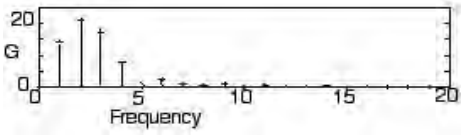




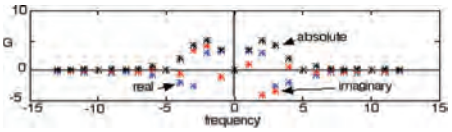
and G is a single frequency, just like it ought to be. We played with g and learned that adding a string of zeros that were at least 5 times the duration of g.



This fft of g with added zeros gives a better estimate of G.



The result of the Fourier-integral- summation of one cycle of a sine wave is the complex spectrum. The absolute value look like the G for the sine wave with zeros.



I have written a longer discussion on the limitations of fft.

Robert H. Dott, Jr.

A highlight of my year came as a stunning surprise in May when department chair **Cliff Thurber** showed me a book that had come to him in the mail and titled *Frozen In Time* by **Theodore Cohen** (see page 22). Inside was an inscription which said "In honor of Dr. Robert Dott, Jr. and in partial payment of a debt long overdue." There was a very sizable check to the Cline/Pray/Dott fund. Cliff asked if anyone could identify Mr. Cohen. Of course I could do so because Ted had come to Antarctica as field assistant for my PhD student, **Martin Halpern**, who was to spend a second field season on the Antarctic Peninsula in 1961-62. Another of my students, **Kevin Scott**, was along to reconnoiter for a possible PhD project. At that time, the U.S. had no support facilities on the Peninsula, so the four of us traveled with the Chilean Navy across the Drake Sea to conduct our research. Besides assisting Marty, Ted took along a Worden Gravity meter to get data to fill in some gaps in **George Woollard's** worldwide gravity network. After our southern adventure, Ted undertook a PhD project in geophysics with **Robert Meyer**, a seismic study of the Midcontinent Gravity anomaly. When I contacted Ted and expressed my amazement at his generosity and his new career as a mystery writer, he replied that "I had changed his life with that trip," which provided the basis for his first venture into mystery writing.

Another very satisfying event in 2010 was the final approval of our nomination of the Point of Rocks outcrop on the south limb of the Baraboo syncline along U.S. Highway 12 for listing on both the state and federal Registers of Historic Places. This event attracted a surprising amount of attention in local newspapers. The eighth edition of *Evolution of the Earth* co-authored with Donald Prothero also appeared in 2010. It is difficult for me to believe that this book is still popular after 39 years.

I was invited to present several lectures to lay audiences during the year, the most significant being a collaboration with **Charlie Byers** for a talk about the "Young Darwin and his Geological Career" to the Madison Literary Society. We were then asked to reprise our presentation for the "University of the Air" over the state radio network. I concentrated upon Darwin's pioneering geological researches in southern South America while Charlie spoke of Darwin's boyhood and education. Canadian sedimentologist Martin Gibling visited in May to see our lower Paleozoic and Proterozoic pure quartz sandstones and to confer about the challenge they present for genetic interpretation.

In June, Nancy, our daughter Karen and I flew to Malaysia to spend a month visiting our oldest son and his family; Jim is teaching for three years in an international school in Kuala Lumpur. With them we toured widely, including Langkawi Island composed of Gondwana rocks, which include late Paleozoic glacial drop stones. We also visited Borneo to see orangutans and proboscis monkeys. A geological colleague arranged a week-long tour of Sri Lanka, which featured visits to the ruins of several ancient cities and religious sites all surrounded by Archean gneisses. It was interesting to be immersed in a Buddhist culture in that ancient country and in a mostly Muslim culture in Malaysia.

Nancy and I again attended the GSA meeting in Denver in October and enjoyed seeing many

former students and other longtime friends. At year's end, we began preparing for a January safari in Tanzania, which would take us across the eastern Rift Valley, through Ngorngoro Caldera and Olduvai/Oldupai Gorge en route to the famous Serengeti/Serenget Plains.

Louis J. Maher

Retirement gives one time to do the little things like having a Friday lunch at the Big Ten Pub with other oldies like **Dave Mickelson**, **Bob Dott**, and Geography's **Jim Knox**.

Dave Mickelson submitted our book manuscript on the geology of the Ice Age Trail to the UW Press, and it should be published in 2011. My wife and I joined a tour of the wetlands near Prairie du Chien in May and then drove to Bozeman, MT to visit our son Rob who chairs the school's Electrical Engineering Department.

I provided a few of my last remaining bottles of Lycopodium marker tablets to European palynologists in England and France. These are added to sediment samples to estimate the abundance of the "wild" pollen grains in the sample.

In July I attended the Oshkosh Air Show with son Jim, his daughter and his father-in-law, and we had a good time. I also spent a week putting up drywall at a Habitat for Humanity project in northern Madison. I attended the annual Brodhead Air Show with an old high school friend who had flown up from Texas in his own biplane. And during September Jane and I visited the Crane Foundation in Neceda.

The Neotoma group (Neotoma is the Latin name for a wood rat genus—you can imagine what they study) had its meeting in Madison, and I was pleased to be asked to lead the group to see the wonders of Devils Lake in the Baraboo Range. They provided a school bus to carry us, and it reminded me very much of the old student trips I used to run. I had them climb up the East Bluff using the Pothole trail. You may recall that geologist **Dian Kiesel**—now at the UW-Baraboo Center—worked hard cleaning out the potholes so that they could actually be seen. The trail is very steep, and the group's climbers were better than I had expected. We had a photo stop at the top, and I enclose a picture of them and their leader. I told them that field trip leaders always try to cover their tracks in case anyone complains about the group's behavior. You will note I am wearing the Geography Department's "map cow" sweat shirt and a "Badgeria Institute" cap. Everyone got down off the bluff safely, and the only one that tripped on the trail was the leader. There was a nice cook-out that evening, and all said they had an excellent time. My best regards to all of you.

Gordon Medaris

Retirement continues to be filled with travel and research. In January Nancy and I spent a delightful two weeks on Caye Caulker, Belize, snorkeling and savoring Belizean cuisine and Beliken, the local beer. In July, we took a nostalgic trip to Oregon, where Nancy joined an archaeological dig at a Native American site in the Cascades, followed by a few days along the Oregon coast, and culminating in a rendezvous with **Basil Tikoff** to visit my Ph.D. thesis area—a beautifully exposed, metamorphosed ophiolite complex in the Siskiyou Mountains (photo, page 30). October found us in Italy, biking for three weeks along the Po Valley from Milan to the Adriatic Sea—a great region for exploring the Renaissance history of Italy, and of course, again enjoying marvelous food.

I was privileged to be included as a co-author on a major paper by Hannes Brueckner, which summarizes the mantle and crustal evolution of two garnet peridotite suites in the Western Gneiss Region, Norway, based on research carried out over many years by Hannes, myself, Tony Carswell, Bill Griffin, Herman Van Roermund, and Simon Cuthbert (*Lithos*, 2010, v. 117, p. 1-19).

In April, Brad Singer and I presented a paper, "$^{40}Ar/^{39}Ar$ dating of Geon 14 K-metasomatism and hydrothermal alteration the Southern Lake Superior region" at the GSA North Central/South Central Meeting in a session marking Randy Van Schmus's retirement and honoring his career. It was especially enjoyable for me to participate in this session, because Randy and I were classmates at UCLA 50 years ago, and we were the first to recognize the Wolf River Batholith, way back in 1975.

In May I made my annual pilgrimage to the Institute on Lake Superior Geology, this time in International Falls, where **Sue Koellner** (M.S. 1974) and I presented a paper on the comparison of ferromagnesian minerals in the Stettin Igneous Complex and the Wolf River Batholith. And of course, I had to return to the Czech Republic, where I spent three weeks in August, analyzing trace elements in minerals in the Russian Peak igneous complex via LA-ICP-MS and making plans with my Czech colleagues for the 9th International Eclogite Conference, which will be held in Marianske Lazne (Marienbad) in August 2011.

Lou Maher lectures the Neotoma group at the top of East Bluff, Devil's Lake. *Photo courtesy of Lou Maher.*

Dave Mickelson

Hello to all of you! I'm busier than ever and enjoying retirement immensely. Thank you to the many who have contributed funds to help pay for full color in the book entitled *Geology of the Ice Age National Scenic Trail*, which I am writing with **Lou Maher** and Susan Simpson. It is now in copy editing at UW Press. They expect it will be available in bookstores in late summer or early fall. Vin and I didn't travel as much this summer as in the past. Several short trips (mostly work) to Lake Superior. We had large gardens again last summer and in early February we are still eating winter squash and potatoes harvested in September.

I missed seeing former students at GSA in Denver this year. We will for sure make it to the GSA meeting in Minneapolis in 2011. I'll be leading a field trip with **Mark Johnson** and **Kent Syverson**. The Cross Plains Ice Age complex (Wilke Gorge), which many of you visited on field trips, is being developed as part of the National Ice Age Scientific Reserve. Another critical piece of land was added in late fall, and I wrote the geology part of the General Management Plan for the area for the National Park Service. I'm now on the Boards of the UW Lakeshore Nature Preserve and the Ice Age Trail Alliance, so am being introduced to management of nonprofit organizations. ●

UNIVERSITY OF WISCONSIN-MADISON Geology Museum

The numbers are in and last year was phenomenal in terms of attendance. Roughly 9,600 people visited the Geology Museum in April alone due primarily to our new display on the Mifflin Meteorite. When this exhibit opened, it featured meteorites that the week before were part of an object more than two million miles from Earth. After blazing across the night sky on April 14th, this meteor exploded over southwestern Wisconsin scattering fragments across the rural landscape. The first piece discovered was brought to the museum the next morning for verification (see page 14). We have since acquired three pieces of the Mifflin Meteorite with help from the **Friends of the Geology Museum** and the Gorzelanczyk family.

The Friends of the Geology Museum helped purchase this oriented nose cone from the Mifflin Meteorite for our collection.

In 2010, the museum also unveiled new signage on the bedrock geology of Wisconsin. We are now collaborating with the Wisconsin Geological and Natural History Survey to produce a poster version of this exhibit for release later this year.

Additionally, the museum installed the first phase of a 250 square-foot exhibit on early Earth and how research in the department pertains to the search for life elsewhere in the universe. This exhibit was developed with support from NASA and is one of the educational initiatives of the Wisconsin Astrobiology Research Consortium. It includes samples of Acasta gneiss from Canada (4.03 Ga), metasediments from the Isua supracrustal belt in Greenland (3.8 Ga), a stromatolite from the Trendall locality in Australia (3.35 Ga), and a large chunk of conglomerate from the Jack Hills in Australia (3.0 Ga). We are grateful to all the researchers who made this exhibit possible especially **Clark Johnson, John Valley**, and Minik Rosing for contributing specimens.

Also as part of the outreach component of the NASA Astrobiology grant (PI-Clark Johnson), we held our second "Astrobiology Night at the Ballpark" with the Madison Mallards this past June. Grant-funded faculty, post-docs, and graduate students staffed booths where the public could learn about meteorites, extremophiles, and geologic time. Graduate students **Jason Huberty** and **Liz Percak-Dennett** each threw out a first pitch.

In collections-related news, nearly 10,000 pounds of sediment cores from the Arctic Ocean were transferred to the Byrd Polar Research Center at Ohio State University. Amazingly, **Dave Clark** collected this material in the 1960's using an enormous drifting iceberg as a research base. **Carrie Eaton** also received a grant from the National Park Service to curate thousands of rock samples from the Guadalupe Mountains in accordance with new federal guidelines.

The museum once again sent a field crew to Wyoming to search for vertebrate tracks in the Triassic strata of Wyoming. The group endured dreadful weather including persistent rain, hurricane strength winds, and multiple rounds of hail. A tornado was even sighted about a mile from the road on the way to Thermopolis. Undaunted, the team still managed to collect an incredible track assemblage which predates the oldest known dinosaurs by at least ten million years. Some of these reptile footprints even exhibit pebbly skin impressions.

Andrew Honma, Weiqiang Li, Ken Williford and Andy Czaja (aka, Titan, Europa, Mars and Earth) get ready to regale Mallards fans on the habitability of various planetary bodies.

Carrie Eaton and Mel Reusché recline on their handiwork after a summer of packing up sediment cores for shipment to Ohio State.

Jason Smithback, Lisa Lesar and George Rothdrake strain their backs in Wyoming hauling a track-bearing slab from the Red Peak Formation. *Photos, Geology Museum.*

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