GEOSCIENCE NEWS

for the Alumni and Friends of the
Department of Geological Sciences
University of Michigan, Ann Arbor, Michigan

January 1999

30 Year Anniversary: Chuck Wooden at Camp Davis, Wyoming

In this Issue:

Greetings from the Chair

Dear Friends of the Department:

Serendipity – the phenomenon of finding valuable or agreeable things not sought (Merriam Webster Dictionary). Translation: Sometimes nice things just happen!

I have known for a long time about the serendipity factor in the fieldwork we marine geologists do – once in a while the core comes up from the bottom of the sea or lake with an exciting and revealing record that you never anticipated. Twenty years ago I was on the Ocean Drilling Program's drilling ship, the JOIDES Resolution, when a quick decision and a lucky break allowed us to recover what turned out to be the first K/T boundary with an iridium anomaly ever found in the oceans. I have not, however, fully appreciated the serendipity factor as it occurs in the life of our Department.

I had been casting around for a topic for this fall's letter from the chair when one of our most active and interested alums dropped in the office to say hello. He asked about all the normal things that one might be interested in: research activity, enrollment levels, teaching efforts, Camp Davis, building renovations and so on. Finally we came to issues of development. I explained how important gift monies are to us (he knew this already, as I hope all of you do), and how unspent monies are put into accounts that grow over the years, both with the market and with continuing annual additions. At the end of all this I noted that we had been the fortunate recipients of a major windfall – something over $400,000 to support undergraduate scholarships in geosciences. I also made the point that, unlike other large gifts, this one was from a completely unknown source and not the result of development activities undertaken by this Department. The alum pointed out that in thinking about this event, we should remember that sometimes good things just happen.

What happened was that in the late 1950's, Mr. Ernest A. Novak, a U-M BBA and MBA of the post-war era, and not a geologist, wrote a will that resulted in his estate being left to the University to support undergraduates in our Department. The scholarship fund is named for his grandparents, Mr. and Mrs. Simon Czoll. No one in the Department or the development office has any recollection of Mr. Novak or the Czolls. The chair's office in C.C. Little now houses the old book collection of Professors Leverett and Stanley among which is an index of all geology publications from 1939 and before. No one named Czoll appears in this index. If any of you know anything about Mr. Novak or the Czoll family, we would appreciate hearing from you.

We do, however, understand quite well the linkage between essentially all of our gifts and the Department. They come from alums, and spouses and children and families of alums, who have enjoyed their time here with us in Ann Arbor. This summer we were offered a gift of mineral rights. I was delighted that someone wanted to make such a gift, but had to make a number of telephone calls around the University administration to find out how to accept this particular offering.

Our gift-related income derives from two main sources: the results of our annual giving solicitation; the earnings on both the named/designated; and, the general accounts that have resulted from past generosities. Most of this income is used to support undergraduate and graduate students. The largest of the funds is the Scott Turner endowment which we put to two main uses. First we support the travel costs of speakers coming to our weekly seminar series. This brings new ideas to the Department every week and lets students and faculty meet and talk with some well-known earth scientists on a regular basis. Secondly, the Turner endowment supports a number of small awards to graduate students allotted on the basis of a brief proposal. The annual Scott Turner Awards competition occurs every winter; it provides students useful lessons in how to prepare a proposal, and in most cases, the effort is rewarded with a modest amount of funding to accomplish their research objective.

In the last few years many of our alums have been lobbying for another summer reunion at Camp Davis. Elsewhere in this issue you will find an outline of what we have in mind. This will be the 10th anniversary of the first reunion held in association with the Department's sesquicentennial celebrations, and, more importantly, will mark the 30th anniversary of Chuck Wooden's first summer on the Hoback River. So set aside August 10-12, 1999, on your calendar and join us at Camp Davis for good times, good food, and a tribute to Chuck.

Sincerely yours,

David K. Rea

David K. Rea
Professor and Chair

Camp Davis Reunion, August 10–12, 1999
Still Time to Register!

Pandemonium will reign in a few months, and there may even be a riot, as 'stragglers' use every method at their command to get on the list of those coming to the Camp Davis reunion on August 10-12, 1999! Yes, from the responses so far the outlook is for a reunion to exceed the extremely successful one of a decade ago.

To prove my point, let me give you the statistics from the questionnaire sent with the June 1998 *Geoscience News* (all numbers that follow include spouses, children, etc.):

Definitely coming: 54
Will come if possible: 55
Can't decide this far in advance (but interested): 10
Regrets (because of previous commitments but with all best wishes): 4

Most (70%) have chosen to 'return to their roots' and will stay at camp, either in cabins or RVs or tents. The remainder (30%) will stay in motels in Jackson (nobody has opted for the Presidential Suite at Jenny Lake Lodge so it is still available).

To join old friends and colleagues for a few days of fun and nostalgia, please complete and return the official registration on page 23 at your earliest convenience. This will guarantee your place in the last reunion of the millennium!

In my June announcement of the forthcoming 1999 reunion I gave several reasons why it was appropriate to have such an event at this time, especially the opportunity for all to see the major renovations to the infrastructure as a result of two very generous gifts and important college funding. Now I can add yet another: the summer of 1999 will mark the 30th anniversary of Chuck Wooden's arrival on the Hoback and, as part of the reunion festivities, we want to celebrate his service to the Department and dedication to Camp Davis over these many years.

Activities will include one of the famous camp bonfires and barbecues, family recreational activities around camp, fishing in the Hoback, a not-too-strenuous field trip, and of course the wide array of touristic activities in the Jackson area and in Teton and Yellowstone National Parks.

On behalf of the Alumni Advisory Board and the members of the Department, I encourage all of you to consider joining the multigenerational group that will assemble on August 10-12 for a Camp Davis reunion. You, too, can be part of history!

Alfred (Al) A. Levinson, Chairman
Geological Sciences Alumni Advisory Board
(1993-1998)
Department of Geology
University of Calgary
Calgary, Alberta, Canada T2N 1N4
e-mail: levinson@geo.ucalgary.ca

Camp Davis 440 Class of 1973
Reunion Held in August

A small but spirited group re-united at Camp Davis in August to rekindle memories of Camp Davis. The class of 1973 reunion was organized by John Geissman, who unfortunately was called home the day before the reunion began. Chuck Wooden hosted the event and provided a great assortment of goodies including some wonderful elk steaks. The Eardley cabin served as the focal point for the reunion, where our days began cooking a hearty breakfast at the cabin. Dinners were prepared at Johnson Hall and included some riotous games of foosball and ping-pong by the younger generations.

The daytime events included memorable trips to the Granite Creek Hot Springs, hikes in Grand Teton National Park, fishing in the Hoback, and a wild raft trip down the Snake River Canyon. The evening events always included a campfire at the old campfire ring, consumption of beverages, and ever more hilarious stories from the past. Those not in attendance were topics of many of the conversations. We especially remembered those who have passed away, including Dr. John A. Dorr who was a great inspiration to many in our class. He wrote us in 1983 that he fondly recalled our class as one of his great ones.

Three members of the Class of 1973 decided to leave a memory of our 25th reunion. Steve Henry, Jack Kosztowny and Fred Metzger decided to re-build the campfire pit. At least 25 wheelbarrows of ashes were cleaned out of the pit. (We figured some of our trash from 1973 was still in the pit.) Hoback River cobbles were collected near camp property and hauled back to Camp. Steve Henry has become a proficient stone mason, and he mortared the cobblestones into a permanent campfire ring. Hopefully the ring will be enjoyed by many future classes as well as by the big all-class reunion scheduled for August 1999.

Welcome Incoming Graduate Students

The Department is delighted to report that 13 new students have joined the graduate program in the Fall semester 1998. Their names, undergraduate institutions, and areas of interest are shown below. A warm welcome to all!

Erik Ekdahl, Carleton College; sedimentology, oceanography, and aspects of climate change

Shawn Wolfe, Cornell College; vertebrate paleontology (cetaceans and non-dinosaurian lower vertebrates) and taphonomy

Bill Hubbard, College of Wooster; archaeological geology

Jennifer McIntosh, Whitman College; low temperature geochemistry

Iyad S. Zalmout, Yarmouk University-Irbid, The Hashemite Kingdom of Jordan; vertebrate paleontology and evolution with an emphasis on the sharks and rays of Cenozoic and Mesozoic age

Erika Williams, Haverford College; aqueous geochemistry, radioactive waste management

Sarah Smalheer, Smith College; carbonate sedimentology

Weidong Dong, Peking University; petrology

Joan Steurer, University of Missouri, Columbia; geophysics, tectonics, geodynamics

Ross Secord, University of Nevada, Reno; mammalian biostratigraphy, application of stable isotope data to problems in vertebrate paleontology, Paleogene mammalian evolution

Larry Jordan, SUNY Buffalo; soft rock geology with interests in sedimentology and low temperature geochemistry

Zaojun Ye, China University of Geosciences-Wuhan; isotope geochemistry, ore deposit geochemistry and environmental geology

Alexander Bradley, Harvard; paleontology and geochemistry

Honors, Awards, Kudos

John J. Amoruso (MS '57) of Amoruso Petroleum in Houston has been awarded an Honorary Membership in the Society of Independent Professional Earth Scientists.

Bob F. Perkins (PhD '55) has been awarded Honorary Membership in the SEPM in recognition of his many years of sustained efforts in promoting and facilitating the dissemination of sedimentary geologic information through publication of the SEPM Foundation's Research Conference Proceedings Volumes.

Paul Koch (MS '85, PhD '89) of the University of California-Santa Cruz has been awarded the 1998 Schuchert medal of the Paleontological Society.

Neil F. Hurley (PhD '86) of the Colorado School of Mines has been named editor of the AAPG Bulletin.

Lisa Cirbus Sloan (Post-doc '90-'92), now at the University of California-Santa Cruz, has won a five year Packard Foundation Fellowship.

James M. Robertson (MS '68, PhD '72), the State Geologist of Wisconsin, has been selected as the 1998-1999 President-elect of the Association of American State Geologists.

Joaquin Ruiz (MD '80, PhD '83), **David W. Mogk** (BS '75, PhD '84), **Sally J. Sutton** (BS '79), **Donna M. Jurdy** (PhD '74), **James M. Robertson** (BS '73, MS '76, PhD '80), and **Bruce R. Clark** (faculty 1968-78) have been appointed to serve on various committees of the Geological Society of America. John Geissman continues to serve as Editor of the GSA Bulletin.

Bruce Wilkinson (faculty) has been elected a Fellow of the GSA.

Rob Van der Voo presented the 1998 LSA Distinguished Senior Faculty Lecture.

Robyn Burnham, associate professor of biology and of geological sciences and associate curator of the Museum of Paleontology, has been awarded a Fulbright grant by the United State Information

Agency and the J. William Fulbright Foreign Scholarship Board. Robyn will study ecological preferences and distribution of climbing plants in Amazonian Ecuador.

John Bowman (PhD '78) was awarded the University of Utah Department of Geology and Geophysics 1997-98 Distinguished Teaching Award. The citation for John's award recognized his infectious enthusiasm for geology, his modern and rigorous treatment of subject matter, and his concern for students. John was particularly praised for leading a 10-day, department-wide field trip to the Cascades in the Fall of 1997. Bowman has now received this award three times, in 1992-93, 1995-96, and 1997-98, prompting the suggestion that the award be renamed the "John R. Bowman Distinguished Teaching Award in Geology and Geophysics."

At the University of Utah commencement ceremony in June, **David Chapman** (PhD '76) received one of three university-wide Distinguished Teaching Awards. This culminates two decades of recognition for excellence in teaching. Previous teaching awards include Department of Geology and Geophysics Innovative Teaching Award in 1980-81 and Distinguished Teaching Award in 1985-86, a College of Mines and Earth Sciences Outstanding Teaching Award in 1992, and a Presidential Teaching Scholar designation in 1994. Dave was also given the designation University Professor for the academic year 1991-92 which allowed him to develop and teach a general education course "Global Environmental Change" that is now a mainstay in the curriculum. Dave also presented the 1998 University of Utah Gould Distinguished Lecture on Technology and the Quality of Life, addressing issues associated with global warming.

Pollack meets with Vice President Gore on global warming

By Sally Pobojewski
U-M News and Information Services

(condensed from an article appearing in the University Record on October 21)

It is not unusual for an article published in Science magazine to generate a lot of attention. So when U-M geologists Henry Pollack and Shaopeng Huang were notified that their article, "Climate Change Record in Subsurface Temperatures: A Global Perspective," was scheduled to appear in the Oct. 9 issue, they were prepared for phone calls and e-mail messages from journalists and other scientists.

What they weren't prepared for was a personal invitation from the vice president of the United States.

"Monday evening, I got a call from the assistant director of the Office of Science and Technology Policy in the Executive Office of the President," Pollack said. "She told me Vice President Gore had read the Science paper and asked if I would participate in a press conference on global warming with him on Wednesday. Could I be in Washington by Tuesday evening?"

A summons to Washington is not the sort of offer one can refuse, so the afternoon of Oct. 13 Pollack was at Detroit Metro airport enduring a series of delayed flights. He finally arrived in Washington after 9 p.m. to find a waiting message. Because congressional budget negotiations were in a delicate stage, the press conference had been cancelled. Instead Pollack was scheduled for a series of private briefings with Gore and Neal Lane, director of the Office of Science and Technology Policy; and administrators at the National Science Foundation, which has been the principal funding source for his research.

"It was a very relaxed meeting," Pollack said, describing his "15 minutes of fame" in the vice president's White House office. "I was pleased that Vice President Gore had read the paper and found it interesting. He was kind enough to say he remembered my testimony about borehole temperatures and global warming before his Senate committee several years ago. It's clear he is aware of the current state of knowledge in the field."

(see related article on page 11)

Educational Outreach Strategy Involves High School Students in Earthquake Hazard Research

by Jeanne Sauber (BS '76)

(Editor's note: This article is a condensation of one that appeared in EOS, v. 79, n. 33, August 18, 1998, by Jeanne Sauber and co-authors Stephanie Stockman and Thomas Clark.)

NASA has been making precise geodetic measurements to assess earthquake hazard associated with the subduction zone process in Alaska since 1984. In 1995, a new strategy for making geodetic measurements was implemented that included local residents in the measurement program, and in 1997, the program was expanded to include teachers and students at five high schools. For the inhabitants of Alaska, understanding the hazards and underlying physical processes associated with earthquakes has immediate personal relevance. Large earthquakes occur yearly, great earthquakes have occurred during the lifetime of many residents, and the weekly testing of the tsunami warning system in coastal towns is a reminder of the devastation caused by earlier tsunamis generated near Alaska and a cautionary note about future inundation.

In June 1995, a Kodiak Island high school Earth science teacher and seven of his students joined NASA researchers to conduct global positioning system (GPS) measurements at seven sites on Kodiak Island. The educational research program involved the students in research in support of the scientific investigation and increased their understanding of earthquake hazard in their local environment. The inclusion of local residents in the study enabled us to include a larger number of stations at a lower cost, since in the populated regions of Alaska personnel are required at the geodetic sites to safeguard the instruments. In 1995, geodesist Steven Nerem and surveyor Mark Bryant taught the students the theoretical and practical aspects of GPS surveying and they insured data quality by checking the site set-up.

During the geodetic field campaign, science educator Stephanie Stockman conducted a qualitative research study on the students' understanding of the scientific process and their perceptions of scientists. She found that the students had developed a sense of ownership and responsibility for their sites, they demonstrated a deeper understanding of the process of science, and due to their interaction with the NASA scientists, they could look to them as role models. The level of commitment and competence of the teachers and students encouraged NASA to expand the program to include more schools near our sites in southern Alaska.

In 1997, half of the sites in the Alaska research program were observed by teachers and students from the high schools in Kodiak, Cordova, Valdez, Glennallen, and Kenny Lake. Grants were given to the five teachers to enable them to tailor the learning experience to their own educational objectives. The teachers then formulated their own programs in keeping with the measurement requirements.

The program provided a first professional work experience for many of the students. Following the program, the soon-to-be seniors from Valdez were given letters of recommendation that could be used in college applications. It also offered scientists an opportunity to serve as role models for the students. The students gained experience with state-of-the-art technology.

One of the objectives of the educational outreach program was to integrate the GPS study into the school's academic curriculum and extracurricular programs. For example, prior to the first day of observations on Kodiak Island, teacher Eric Linscheid and educator Stephanie Stockman conducted a geological field trip for Kodiak student researchers in order to integrate the GPS study into the school's Earth Science curriculum.

Perhaps of greatest societal importance, the program educated many residents about earthquake risk who would directly benefit from the results of the investigation. For example, most homeowners on Kodiak do not have earthquake insurance. Our study could allow the Kodiak citizens to make more informed decisions regarding earthquake hazard planning. Newspaper articles on the research program were featured in the *Kodiak Daily Mirror*, the *Valdez Vanguard*, and the Kenny Lake High School newspaper. While I have emphasized the benefit to the students and their communities, the teachers also saw the project as an opportunity for professional growth. This year, Linscheid was selected to analyze gamma ray spectrometer data from NASA's Lunar Prospector mission as part of the "Space Explorers" program.

Future educational plans include facilitating the transfer of the earthquake hazard research program by seeking funding to place permanent GPS sites near some Alaskan high schools. The school partners would have full responsibility for these sites. Additionally, NASA is using the educational model of the Alaska program for some of its other projects, such as the Mars Orbiter Laser Altimeter Education Program. The outreach program was structured to educate and train teachers and students, engage them in NASA's scientific and technological enterprise by having them make GPS measurements, and then transfer the knowledge, and hopefully even the research program, to the people who care most about Alaskan earthquake hazard—the local inhabitants.

Capital Campaign: A Final Report

The five year Capital Campaign to benefit the Department of Geological Sciences has just come to a very successful conclusion, and we want to share with you a brief summary of this effort.

Capital campaigns, otherwise known as intensive periods of fund-raising, are part of every day life it seems. If it is not the local symphony or art gallery or science museum asking for your help, then surely it will be your church, synagogue or community center calling for your generous support. And, institutions of higher education are never far behind, urging you to invest in the future by providing that extra margin of assistance that will provide excellence and opportunity for the students of the next generation and beyond.

In this context, we can summarize the Department's Capital Campaign concisely: your response was outstanding! The raw numbers are impressive. Over the five-year period, 413 alums, friends and corporate benefactors of the Department contributed and/or pledged $4.3 million. About one-third of these funds have been immediately available for real and present needs, whereas others have been contributed as trusts and bequests of various types that will benefit the Department in the more distant future. We have been advised by ten alums that the Department has been designated a beneficiary in their will. We wish them a long and happy life, and extend our deep gratitude for their thoughtful consideration.

But there is more to report about this campaign than just the raw numbers. Each and every gift has a little story behind it that elevates it from the realm of mere numbers to a higher plateau of touching human interest. Let us tell you about some of the particularly special gifts.

• **Arun Sharma**, a petroleum engineer with Mobil, has established an endowment in honor of his father **Ganshyam D. Sharma** (PhD '61), to provide annual scholarship support for a graduate student. Some of our Geoscience News readers will remember G. D. Sharma when he studied petroleum geology with Ken Landes in the late 50's. Sharma, as he liked to be called, went on to a distinguished career at the University of Alaska in Fairbanks. He retired just a few years ago, and is now at Stavanger College in Norway, continuing to lecture on sedimentary geology. I am sure that there is no father in the world who would not be touched by such a wonderful commitment from his son.

• **Konrad Kruger**, **Thomas Kruger** and **Julie Kruger Bailey** and their families have established an endowment in memory of their mother, **Susan Manchester Kruger**. This gift provides annual scholarship support for a graduate student. Susan Manchester was an undergraduate in the Department in the 1930's, and regaled her children with geological explanations as they beat through the bush and over the mountains of Venezuela where the family was posted as an employee of General Motors. The Kruger children recall their mother's enthusiasm for geology with great affection, and wanted to help others have similar opportunities.

• **Jan Kappmeyer** (MS '82) and **Drew Isaacs** (BS '78, MS '81), a geological husband-and-wife dynamic duo, have made major gifts to support innovative research performed in the Stable Isotope Geochemistry Laboratory and to bring modern instructional technology to Camp Davis. Both recall their student days at Camp Davis, and recognize the ongoing need for fieldwork in the geological curriculum. Jan and Drew both have served on our Alumni Advisory Board, and Drew also sits on LSA's Corporate Advisory Council. Vacation time usually includes a visit to Camp Davis and an occasional meeting up with one or another of the Department's Fall field trips.

• **John Greene** (BS '63, MS '70) and his wife **Jean** have established a charitable remainder trust to benefit Jean's mother, and later to benefit the Department. John recalls the opportunities opened up to him because the Department was willing to take a chance on someone fresh out of military service, with a biology major and not-so-great grades. For many years John managed the recruiting pipeline through which several Michigan students joined Conoco. John himself later worked as a vice-president for Louisiana Land and Exploration, but many of his recruits are still with Conoco. John always believed that a Michigan student was a quality product and a prized recruit. John served as a bulwark of our Alumni Advisory Board in the years following its establishment in the early 1980s.

• **John Joity** (BS '71, MS '73) and his wife **Donna Marie** have year in and year out provided a solid foundation for our annual giving program. Their gifts, generously matched by Exxon and always undesignated so that the Department may have the flexibility to use the funds to address the most pressing needs, have reached students in a myriad of ways. John and Donna Marie have also made generous provisions for the Department in their estate plan, which sets in place a mechanism for what will be the Department's first fully-funded professorial chair. While John was pursuing his graduate studies in the Department, Donna Marie was a key element in the office team under the watchful eye of Ada Haydon, the long-time Department matriarch. John served on the Alumni Advisory Board for several years, guiding it effectively as Chairman in his latter years of service. John and Donna Marie regularly vacation in the Tetons, a locale they fell in love with following the Camp Davis experience.

• **John Geissman** (BS '73, MS '76, PhD '80) and wife **Molly** have made a commitment to assist construction of a new classroom building at Camp Davis. John has for years been a mainstay of our teaching staff at Camp Davis, notwithstanding his faculty appointments first at the Colorado School of Mines and now at the University of New Mexico, where he also is involved in teaching UNM's field courses. John has an apparently infinite supply of Maize and Blue blood and regularly finds important business in Michigan during the football season. John has also been instrumental in organizing camp reunions of the Camp Davis class of '74.

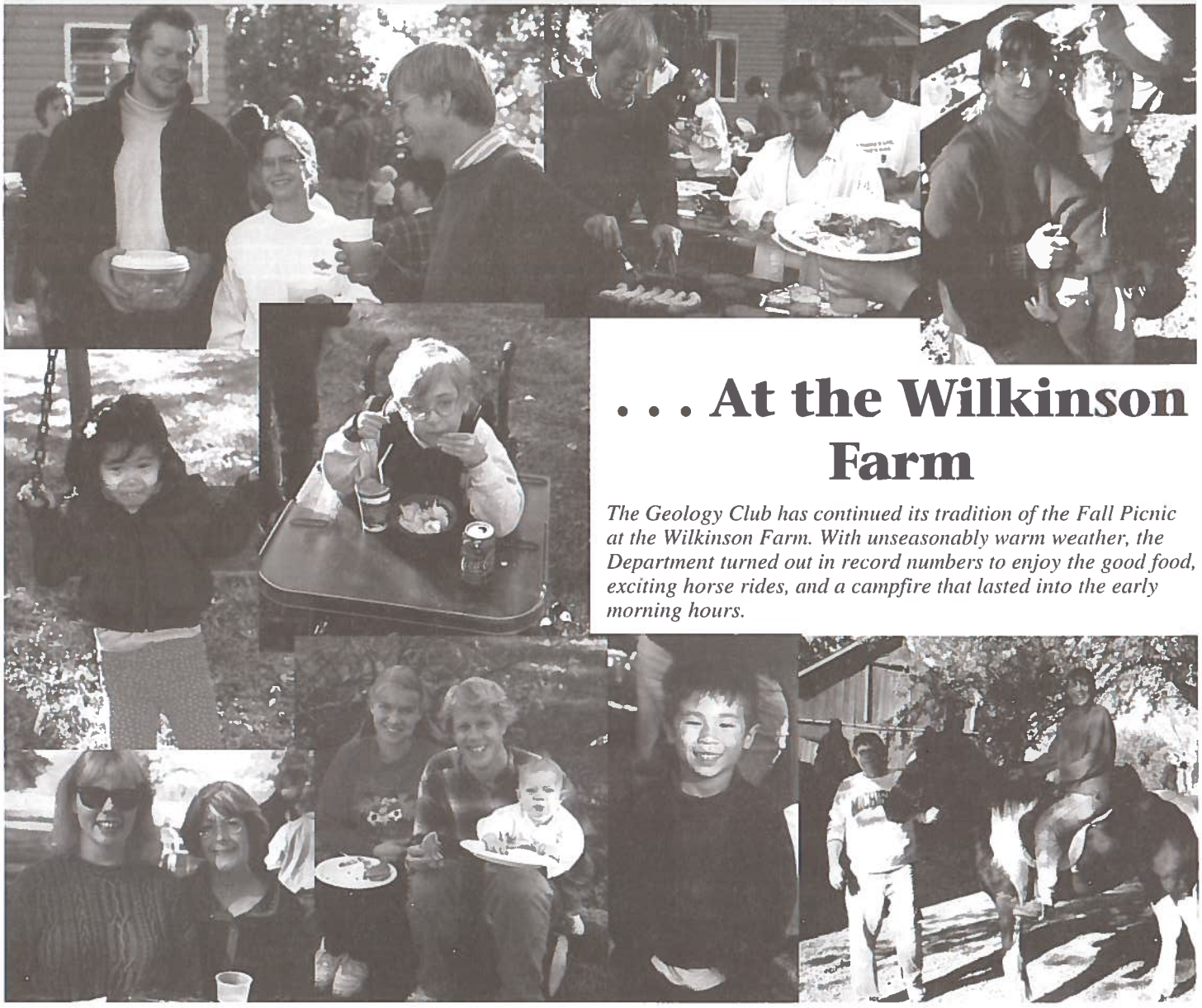
• A recently retired alum from the petroleum industry has provided an important gift to establish a Field Activities Fund.

All students who have studied geology at U-M have come to recognize that Ann Arbor sits in a "geologically-challenged" location, and that we must work doubly hard to provide proper field experiences during the academic year. This gift will enable an entirely new level of field activities to develop from the campus, and will ease the financial burden that participation in field trips has placed on students.

• As Dave Rea noted in his Chairman Greetings, the Department just last July was pleasantly surprised to learn that the estate of **Ernest A. Novak** had provided very substantial funds to support undergraduate scholarships in the geological sciences. The scholarships will be known as Czoll Scholarships in honor of Mr. Novak's grandparents, **Mr. and Mrs. Simon Czoll**. Mr. Novak was not a geologist, and we have not yet determined what connections the Czoll family had with the geosciences. However, the scholarships in their name will have a great deal of significance for geology in the future, as outstanding undergraduates are attracted to the Department and the geological profession. This year, four of our exceptional undergraduates, Brita Graham, Erin Himrod, Laura Kaminski, and David Kim, have received scholarship support for their studies in the Geological Sciences.

• The Department is honored to have received a substantial gift from the W. M. Keck Foundation to establish a world class facility for studies in elemental geochemistry. These funds, in combination with substantial support from the College of LSA and the National Science Foundation have enabled the construction of the W. M. Keck Elemental Geochemistry Laboratory which houses an HR-ICP-MS (High Resolution Inductively Coupled Plasma Sector Mass Spectrometer) along with ultra-clean chemistry facilities for sample preparation. This laboratory will serve as an analytical resource for all members of the Department and foster the continued growth of interdisciplinary studies.

Department Picnic . . .



. . . At the Wilkinson Farm

The Geology Club has continued its tradition of the Fall Picnic at the Wilkinson Farm. With unseasonably warm weather, the Department turned out in record numbers to enjoy the good food, exciting horse rides, and a campfire that lasted into the early morning hours.

Honor Roll of Contributors 1994–1998

Individuals:

Yvonne M. Albright
Amanda Alexander and Peter Ford
Thomas J. Algeo
Margaret and Lawrence Allard
Mr. and Mrs. William H. Ames
Camille and John Amoruso
Norbert L. Archbold
Laura S. Badalamenti
Dorothy W. Bailey
Juliane K. Bailey
Joseph R. Baily
Joseph and Linda Baily
Scott and Janice Baird
Giulio G. Baldrighi
Eric and Doris Ball
Adeline and Frank Barnes
Frank M. Barnes
Gordon L. Barnes
John M. Barnes
William S. Bartels
Howard F. and Collene R. Bartlett
Robert A. Basse and Lisa Korner
William and Juliet Beauclair
Barbara and Julius Beers
Catherine D. Belknap
Mr. and Mrs. Richard W. Benner
Herbert S. Bensinger
Mrs. Abigail W. Bethke
Robert and Mary Blair
William B. Borrmann
Erika J. Boss
Mr. and Mrs. John R. Bowman
William H. and Helen J. Boyer
John R. Branch
Mr. and Mrs. Arthur Brandon
Robert H. and Jean C. Breitenwischer
Kenneth G. Brill, Jr.
Thomas Brocher and Anne Okubo
Carolyn Broderick
David R. and Godela Brosnahan
Chris D. and Alisa M. Brotherhood
Lee Anne Brouhard
Roger Brown and Denise Carty
Robert and Marjorie Bryer
Margaret Buckwalter
Mr. and Mrs. Curtis W. Burgess, Jr.
Mr. and Mrs. Charles E. Buzby IV
Matthew Douglas Cabell
James E. Campbell
Lois J. Campbell
Albert B. Carlisle
William S. Carlson
Jean R. Carpenter
Lily Marie Carter
Nancy and Richard J. Cassin
Steven A. Catlin
Donald H. Chapman
Mr. and Mrs. Mitchel E. Cheney
Orlo E. Childs
Elizabeth Swisher Childs
Paul E. Christensen
Howard S. Christie
Bruce and Karen Clark
Eleanor Irwin Cochrane
Brian P. Cohee
Michael R. Cooper
Alice S. and Allen F. Corey Trust
Kit B. Cornell
Lawrence Coskey
Anita and John Cotton
David and Dorothy Courtis
Dr. and Mrs. Raymond M. Coveney
Hanley B. Cox
John P. Craddock
Robert W. Culver, Jr.
Alan D. and Louise Curtis
Ruth B. and Bruce F. Curtis
William Gerald Cutler
Teresa S. and Timothy S. Czarnik
Lana Ann Czerniakowski and Ron B. Stokes
Massis Davidian
Dorothy W. David
Lawrence Harold David
Dorothy Wright Davis
Essie M. Dean
LaRoy Dean, Jr.
Susan and Cornell Dejong
Helen G. Denning Trust
David B. DeWitt
John H. and Sally A. DeYoung, Jr.
Karla Diapond
Edward Dibble
Thomas P. Dickerson
William and Kathleen Dixon
Mr. and Mrs. Kenneth L. Doe
Mrs. Ruth P. Dorr
Robert H. and Nancy R. Dott
Carolyn Downey
Ben Eric Drake
Nancy DuBois
William L. Duggan
Richard G. Dunlop
John and Alma Durr
Jeni Durst
Daniel and Sheri Eastman
William W. and Beulah E. Easton
Robert and Grecia Edwards
Allen and Mary Ehlers
Donald A. and Elsie L. Ehman
Ruth Engel and Zevi Miller
Drs. Lance and Helen Erickson
Mary and Jay Erikson
Thomas Ervin and Margaret Johnston
Mrs. Marion Escallon
Ralph E. Eshelman
Eric J. Essene
John A. and Marilyn L. Fagerstrom
Marion K. Fake
Jefferson Eitig Faye
Mr. and Mrs. Robert H. Fear
Melanie and Russell Feather
Arthur Thomas Fernald
Anne G. Fitzpatrick
James L. and Nancy M. Folcik
James T. Forsythe
Helen L. Foster
David M. Fountain
Mr. and Mrs. Robert L. Freed
Stefany and Gary Freeman
Dr. and Mrs. Eugene H. Freier
Mr. and Mrs. Alfonso F. Geiger
John W. and Molly A. Geissman
Andrew H. Gibson
Janice H. Gibson
Helen and John Gilbert
William H. Glezen
Mrs. Edwin Goddard
Paul Goldberg
Jose J. Gomez-Reggio
Mr. and Mrs. Aris G. Grammatikas
Dr. and Mrs. Henry H. Gray
John and Jean Greene
Greene-Pierce Trust
Albertta F. Grimshaw
Mr. and Mrs. Ray B. Gripman
Robert D. and Ruth S. Haag
Merrill W. and Maria Haas
Shlomo A. Hagai
Jonathan Tryon Hagstrum
Richard Hamburger
Rena Hansen
David G. and Ann L. Hardy Trust
G. Robert Harrington Trust
Joseph Harold Hartshorn
Margaret J. Hastedt
Mr. and Mrs. John B. Hazelworth
Steven Henry
Mr. and Mrs. Theodore C. Herman
Charles H. and Janice L. Hewitt
Harvey E. Hienbach
Donald E. and Barbara M. Hillier
Sumner and Helen Hixon
Gary and Julie Holloway
Douglas A. Holmes
Judith J. and Bradley R. Horn
David A. and Wendy S. Howell
Walter E. Hull
James D. Hume
Suzanne J. Hurter
Karen J. Husby-Coupland
Jeffrey and Mary Huspeni
Jordan N. Hymowitz
Philip C. Ingalls
Andrew M. Isaacs and Janet Kappmeyer
Valerie A. Johnson
Nancy N. Johnson
John and Donna Marie Joity
Robert J. Jones
Donna Jurdy and Michael Stefanick
Thomas Charles Juster
Charles J. Kaiser
Edwin and Ilse Karp
Mr. and Mrs. Haig F. Kasabach
Janice M. Keller
John W. and Sally W. Kendrick
Nancy Keppelman
Cecil C. Kersting
Stephen E. Kesler
John E. Kilgore
William A. Kneller
Edwin and Katherine Knetzger
Mr. and Mrs. Jack A. Kohn
John and Rita Kosztowny
Alexander A. Krezel
Paul Krueger
Konrad and Marie Kruger
Madlyn M. Kruger
Thomas E. Kruger, Jr.
Mr. and Mrs. George R. Kunkle
Henry and Laureen Ku
Ellen A. Lake
Mary and Wallace Lamoreux
William E. and Joann C. Langenbahn
Rebecca A. Lange
Chester C. Langway, Jr.
Charles G. Lee
Arthur W. Leibold III
Martha M. Levandowski

Alfred A. Levinson
Richard and Barbara Ley
Mr. and Mrs. Richard Liddicoat, Jr.
Robert M. Linsley
Mark Lipton
Linus R. and Barbara J. Litsey
K. C. Lohmann
Art D. Lombard
Miss Persis M. Long
J. Stewart Lowther
Peter and Therese C. Lucas
Curtis L. and Patricia W. Lundy
Christopher and Patricia Lynnes
James G. Mackay
W. Bruce and Lorraine L. Mackenzie
Richard and Marian Mahard
William J. and Helen R. Malin
Ann M. Manchester
Georgia Manchester
Stephen L. Manchester
Thomas C. Manchester
Lawrence E. and Emily L. Mannion
Susan Markert
Philip L. Martin
James A. and Mary W. Masterson
Margaret T. McCaul
John S. and Justine McDonald
Mr. and Mrs. Duncan J. E. McGregor
Wardley D. McMaster
Donald A. and Betty Medwedeff
Mr. and Mrs. John S. Merchant
Frederick W. and Laurie Metzger
Arthur J. Meyers Estate
Philip A. Meyers
Anthony S. and Phyllis Mignery
Abigail Miller and Robert Ryder
Gregg and Susan Millman
Christine C. and Craig M. Monroe
Margaret E. Mooney
David P. and Anne W. Morley
Katherine M. Muir
George H. Musselman
Marianne M. Nagel
Winifred L. Nashi
Joan P. Neuschler
Samuel and Paula V. Nicholls
Ernest A. Novak estate
Stephen Nowaczewski
David Nussmann
Lawrence and Sueann O'Brien
Hannah E. Ohr
Barbara and Peter Olsen
Mr. and Mrs. John P. Olsen
James R. O'Neil
Robert M. Owen
Alan R. Paul
Frances Manchester Pendleton
Russell E. and Loretta K. Perigo
Dexter and Elizabeth Perkins
Erich U. and Nancy M. Petersen
Richard J. Pike
Mr. and Mrs. James A. Pi-Sunyer
Mr. and Mrs. David W. Plumer
Lana and Henry Pollack
Robert J. and Nancy Ann Rabe
Christopher R. Rampson
David K. Rea
Carol A. Rector
Leon and Harriet Reiter
Mr. and Mrs. Bruce Renaud
Dorothy and Robert Reuss
James and Merrilyn Rhodes
Mr. and Mrs. Robert T. Riedel
Dr. Charles J. Ritter
Dr. Marrianne H. Robertshaw
Dr. and Mrs. Frederick L. Roeser
Mr. and Mrs. James P. Rogers
Mr. and Mrs. Robert B. Rosowski Trust
Mark Allen Ryan
Dr. and Mrs. Edward G. Sable
Anne and Steve Sanford
Lowell Robert Satin
Nathan Schafer
Tracy L. Schauer
Mr. and Mrs. Stephen S. Scherer
Bettina R. and Evans Schmeling
Robert Scholten
Ronald E. Seavoy
Bruce Kim Shanahan
Arun K. Sharma
Dr. and Mrs. Ghanshyam D. Sharma
Dr. Yen-Hong Shau
Robert J. Shedlock
Edward C. Silverman
William B. and Karen Simmons
Dorothy M. Skillings
Audrey E. Smith
Lawrence R. Smith
William T. and Barbara B. Smith
Mrs. William T. Sparrow, Jr.
Darwin R. and Sue A. Spearing
Linda Sperling
Donald Lee Sprague
Edward and Deborah Stankevich
Lee L. Stroves
James F. Struhsaker
Winifred Stubenvoll
Devere and Zita Sturm
Waldo D. Sturm
Elizabeth M. Sugar
Dongwoo and Chongmi Suk
Mr. and Mrs. John M. Sweet
Krystyna Swirydczuk
Yuichiro Tanioka
Derek and Betty Tatlock
Elizabeth Terando
Bart W. and Naz Tichelaar
Mr. and Mrs. Clarence N. Tinker
Scott and Allyson Tinker
Debra Tjoa
Sean M. Todaro
Peiti Tung
John and Tina Tyler
Ben van der Pluijm
Rob Van der Voo
Mr. and Mrs. Charles K. Veenstra
Richard and Janice Vian
Robert K. and Dinah K. Vincent
William Vogt and Claire Eberwein
Mr. and Mrs. Joseph L. Vojir
Andreae and John Waanders
John C. Wagner
Mary and Eugene Walker
Dr. Stewart R. Wallace
Mr. and Mrs. Jackie L. Watkins
Donald W. and Mary L. Watson
Alice E. and Paul L. Weis
James E. M. White
Edwin D. Williamson
Howard and Beth Williams
John A. and Sandra V. Williams
Dr. and Mrs. Michael D. Wilson
Mr. and Mrs. Gary A. Winter
Howard R. Witt
LeeAnne Wolanyk
Laurel G. Woodruff
Carolyn R. Woodward
Mr. and Mrs. George L. Worden
Dr. and Mrs. Richard V. Wyman
Jiajun Zhang
Youxue Zhang
Shijie Zhong
Jean P. and Paul W. Zimmer

Corporate:

AFMS Scholarship Foundation
Amerada Hess Corporation
American Chemical Society
Ameritech Foundation
Amoco Foundation, Inc.
Amoco Production Company
ARCO Foundation, Inc.
Armco Foundation
Baily Engineering and Testing
Baltimore Gas & Electric Co.
Barrick Goldstrike Mines, Inc.
Bechtel Foundation
Berkshire Hathaway, Inc.
Burlington Resources Foundation
California Technology International
Chevron Petroleum Technology Co.
Chevron Products Co.
Chevron USA, Inc.
Citicorp Foundation
Conoco, Inc.
Consolidated Natural Gas Co. Foundation
Cyprus Amax Foundation
Exxon Company USA
Exxon Corporation
Exxon Education Foundation
Fina Foundation
Ford Motor Company Fund
General Motors Foundation, Inc.
John F. Greene and Co.
Lockheed Martin Corporation
Louisiana Land and Exploration Co. Foundation
Marathon Oil Foundation, Inc.
MichCon Foundation
Michigan Consolidated Gas Co.
Mobil Foundation, Inc.
Norian Corporation
Occidental Oil and Gas Charitable Foundation
David and Lucille Packard Foundation
Paramount Comm. Foundation
PPG Industries Foundation
Rohm & Haas Co.
Sapphire Instruments
Shell Development Co.
Shell Oil Co. Foundation
Shell Western E&P, Inc.
Tandy Corporation
Tenneco Management Co.
Texaco Philanthropic Foundation, Inc.
Union Oil Company of California Foundation
Union Pacific Corporation
USX Foundation, Inc.
Vastar Resources Inc.
W. M. Keck Foundation

Underground Temperatures Reveal Changing Climate

by Henry N. Pollack and Shaopeng Huang

(Editor's note: This article appeared in the August 1998 edition of Geotimes, and is reprinted here with permission)

Probably no other scientific topic dominated the 1997 news so completely as did Earth's climate. Along with the recurring waves of El Nino related storms, the topic of long-term global climate change was also a favorite subject, particularly as the Kyoto conference on greenhouse gas emissions was approaching at year-end. When the discussion of climate change engages not only scientists, but also industrialists, economists and politicians, you know something of significance is on the table. The issue, of course, is whether the warming of the Earth that has been occurring since the late 1800's is simply a manifestation of natural climate processes, or a result of increasing concentrations of greenhouse gases in the atmosphere due to human activities such as the burning of fossil fuels. A few voices still question the validity of the observations that indicate that the Earth has warmed and that greenhouse gas concentrations in the atmosphere are increasing, but for the most part concentrations in the atmosphere are increasing, but for the most part there has emerged a consensus that both phenomena are real. The debate is now centered on whether the changing atmospheric chemistry is the cause of the global warming, and if so what will be the consequences in the next century and beyond, and what can or should be done to remediate the situation.

Earth scientists continue to play an important role in setting the scientific foundations for the debate, in part by illuminating the characteristics of past climate changes so as to understand better the fluctuations in the climate system before there was any possibility of anthropogenic influences. As all geologists know, the Earth is always changing, on time scales that vary from annual to decadal, millennial, and into the millions and even billions of years. But if we are to identify and assess a possible human impact associated with the utilization of fossil fuels, we must focus attention on an interval of time that encompasses both the industrial and pre-industrial eras, i.e. approximately the past several hundred years of Earth history, and on the natural climatic processes that may fluctuate significantly in such a time interval. Conveniently, humans have been keen instrumental observers over the most recent century, patiently taking the Earth's temperature and measuring the precipitation and other climatic variables at weather stations all over the globe. But in prior centuries we must reconstruct the temperature and other climatic factors from natural rather than human archives. In this endeavor climate proxies such as found in tree rings, coral growth, ice cores, lake sediments and loess deposits provide insights into the characteristics of past climate fluctuations, whether natural or anthropogenic in origin.

Another important type of data relevant to reconstructing the surface temperature variations of the recent past resides in a rather unlikely place: beneath our feet. What is it that the subsurface has to contribute to climate reconstruction? In a nutshell, it is the temperature of the rocks at relatively shallow depths beneath the Earth's surface. The underlying principle is simple: if the atmosphere of the Earth is warming, the rocks in the uppermost part of the Earth's crust will also warm. A familiar analogy will give a feel for the process: when you pour hot tea into a cold cup, the temperature change that the interior of the cup experiences can be sensed a short time later in the warming of the cup's exterior, as heat is transferred from the cup's interior to the outer surface. Similarly, temperature changes that occur at the Earth's surface propagate slowly downward into the rocks beneath the surface. Thus present-day rock temperatures at shallow depths provide evidence of temperature changes that have occurred at the surface in the recent past. The pace of heat conduction in rocks is such that the past five hundred years of surface temperature history is imprinted on and contained within the upper 500 meters of the Earth's crustal rocks. This historical record or archive exists almost everywhere on the continents, where the atmosphere and the solid surface are in direct contact. The archive can be accessed by drilling a borehole and lowering a thermometer to obtain a profile of rock temperature vs. depth. This observed profile can then be interpreted to reconstruct the temperature history at the Earth's surface that produced the present-day rock temperature profile.

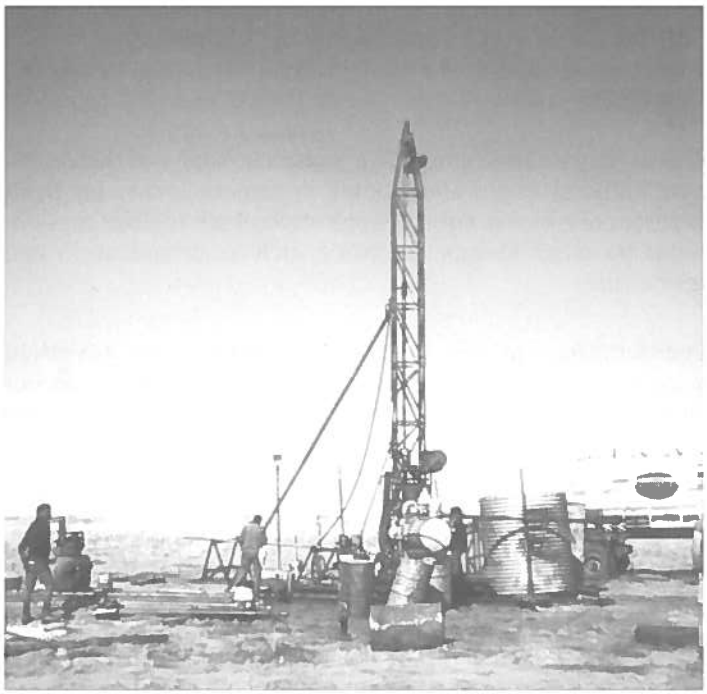


Figure 1. Drill rig boring into the Earth, creating another opportunity for taking the Earth's temperature below the surface

The idea that subsurface temperatures contain information about past climate change is not new. In the early decades of the 20th century temperature measurements in the mines around Lake Superior were analyzed to see if the effects of the Pleistocene glaciation could be identified. Later, attempts were made to assess the magnitude of the climatic disturbance on measurements of the heat flowing outward from the Earth's interior. But it has only been in the last decade or so that geothermal researchers have been making serious efforts to use borehole temperature profiles from all of the continents to reconstruct the history of the Earth's surface temperature, particularly for the past five to ten centuries. Geothermal studies have clearly moved into the arena of modern global climate change investigations.

A number of characteristics of this geothermal archive make it attractive as a source of information about recent climate change. Perhaps first and foremost, the data comprise direct measurements of temperature to reconstruct a temperature history. Unlike many proxy data such as that derived from tree rings or coral growth patterns, which require an empirical calibration relating ring thickness or isotopic ratios to temperature, the subsurface measurements need no empirical conversion. The primary observations are already direct measurements of temperature with a thermometer. From the perspective of temporal resolution, however, the geothermal data are complementary to other proxies. Whereas tree rings for example have excellent annual resolution but less ability to identify long term trends, the geothermal data are best used to illuminate longer term trends of temperature, but only in rare circumstances can they offer information about annual variations. Another important aspect of the geothermal data is that there are many thousands of boreholes worldwide in which temperature measurements have been made, thus providing a large and well distributed archive that enables both local and global assessments of climate change. The fortuitous availability of so many borehole temperature profiles for climatic analysis stems from the focused international effort, roughly from 1960-1990, to measure and map the flow of heat outward from the Earth's interior. Many of these sites were mineral exploration holes in remote areas, far from disturbances to the subsurface temperature regime brought about by other human activities such as urbanization and agriculture.

Temperatures in the shallow subsurface are governed principally by two processes, the flow of heat from the deeper interior, and changes of temperature at the surface. In the absence of any climatic or other surficial perturbations, the temperature in the subsurface reflects only the deep crustal heat flow, and is characterized (in a homogeneous medium) by a linear increase of temperature with depth which is commonly known as the geothermal gradient. If there are temperature changes taking place at the surface, they propagate downward from the surface, disturbing the temperatures represented by the geothermal gradient. But the disturbance gets smaller as it goes deeper, and at some depth becomes imperceptible. The shape of the disturbed temperature profile, and the depth to which the disturbance can be observed are the essential characteristics that are analyzed to reconstruct the history of changing temperature at the surface.

Figure 2. Geophysicists at a borehole site, making temperature measurements with an electrical resistance thermometer.

But one must be cautious in reconstructing climate from subsurface temperatures, because there are many other processes and factors aside from climate change that can affect temperatures in the shallow subsurface. Several fall into the category of changes to the local microclimate due to human activities such as deforestation, agricultural expansion and wetland destruction. Aspects of the local topography, hydrology and vegetative patterns can also leave a subsurface temperature signature which can be misinterpreted as changing climatic conditions. Non-uniform rock properties and subsurface geologic structure also distort the subsurface temperature field. Many of these non-climatological disturbances can be quantitatively modeled and their significance assessed, if sufficient information about a site is available. Alternatively one can average the individual results obtained from a number of boreholes spread across a region. Under the assumption that it is highly unlikely that all of the boreholes would have identical topography, vegetation patterns, geological structure or hydrological disturbances, one can more safely ascribe a common signal seen in the ensemble of borehole temperatures to climate change.

What are the borehole temperatures revealing about Earth's changing climate? A very special set of high precision observations from two 3 km deep holes in the ice of central Greenland give a glimpse of some 50,000 years of climate change. They have revealed that temperatures during the last glacial maximum were some 20-25 degrees Celsius colder than the present day temperatures at that location. As the Earth emerged from the last ice age, temperatures in the early Holocene exceeded the present-day temperatures by 2-3 degrees. Gradual cooling followed, and during the Little Ice Age (1400-1850) temperatures were cooler than present by about 0.8-1.0 degrees. Of course what happens in Greenland is not necessarily indicative of what happens all over the globe (polar regions are thought to be places where climate change

is amplified), but at least these borehole temperature reconstructions provide a long term framework with which to compare results from other locations at temperate and tropical latitudes.

The great majority of boreholes are not in ice, and are typically much shallower, in the range of 300-600 meters depth. The time interval for which their temperature profiles provide the most information is roughly the past five centuries, an interval represented in the upper few hundred meters of the Greenland ice cores as well. The International Heat Flow Commission, an organization of geothermal scientists, has had a special working group assembling and analyzing borehole temperature profiles from sites around the world. The data collection now includes observations from several hundred sites, which have been interrogated for a five century climate change signature. The preliminary results from eastern North America, central Europe, southern Africa and Australia show, not surprisingly,

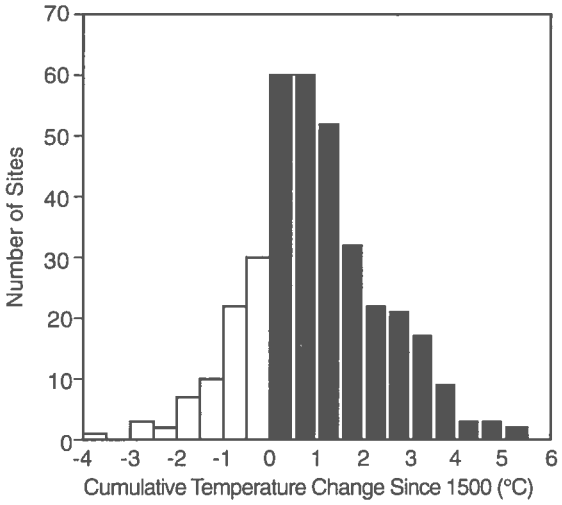


Figure 3. Distribution of temperature change since 1500 at several hundred borehole sites around the globe. Columns with dark shading indicate net warming and columns with light shading indicate net cooling. More than 75% of the sites have experienced warming in this time interval.

a fair amount of regional variability. Some boreholes indicate some modest cooling, others some modest warming, and others yet more substantial warming. But with fully 75% of the boreholes registering a warming of some magnitude, the overall pattern of change emerges clearly. Taken together as a global ensemble, these boreholes document a five century temperature increase (since the year 1500) averaging a little less than 1 degree Celsius, a result very similar to what the Greenland boreholes have shown for their local setting.

When looked at in more detail, this ensemble of boreholes shows that of the total temperature change since 1500, most has taken place since about 1750 (when the industrial revolution began). And about half of the five-century change has occurred

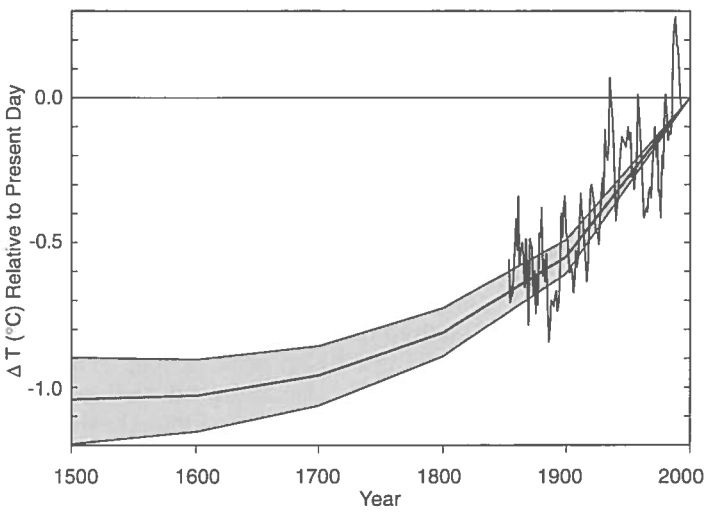


Figure 4. Reconstructed global surface temperature change over the past five centuries, relative to the present-day. The shading represents the standard error of the estimate. Also shown for comparison is a five-year running mean of the globally-averaged instrumental record of surface air temperature since 1860.

in the 20th century alone. This estimate of 20th century warming is fully consistent with the instrumental record of surface warming determined from meteorological observatories and weather station records as documented by the Intergovernmental Panel on Climate Change (IPCC). The rate of warming in the 20th century is four times greater than the average rate of change over the previous four centuries, and has earned for the 20th century the honor, dubious or otherwise, of being the warmest century of any since the year 1500. These geothermal interpretations thus provide an historical perspective that indicates the 20th century has not been just another century in terms of temperature change. In the five century interval illuminated by the borehole temperatures, the 20th century is unusual.

What do these observed temperature changes over the past five centuries suggest for the future? The magnitude of the change since 1500, globally a little less than 1°C, may provide some information about climate sensitivity, i.e. the way the temperature responds to changes in factors that affect it. Human impact on the atmosphere can first be observed around 1750 when greenhouse gases began to increase from pre-industrial levels. If the temperature changes since 1750 are assumed to be due principally to increasing concentrations of greenhouse gases and aerosols from combustion of fossil fuels, then it provides a rough calibration of the way in which the global mean temperature responds to the anthropogenic changes in the atmosphere. If that sensitivity continues into the near future, the anthropogenic changes in the atmosphere anticipated over the next half-century will likely be accompanied by another 1.0-1.2 degrees C of warming, an estimate rather close to the IPCC's "best estimate" of mid-21st century temperatures.

Alumni News

1940s

Mary W. Lamoreux (BS '45) made her annual trip to Michigan from Silver Spring, Maryland, to visit her sisters and families in Lathrup Village, Bloomfield Hills, and Traverse City, Michigan.

1950s

Earl Brabb (MS '52) retired four years ago but works fulltime as a volunteer, mainly making a digital geologic map of the San Francisco Bay region, but he is also using oil well cores to calibrate a seismic velocity model to predict earthquake shaking. He continues to dabble in international landslide affairs.

Patrick R. Cleary (BS '56) retired from the U.S. Navy as a Captain in 1980. He retired from Litton/PRC in 1998 as a Vice-President and General Manager. He has formed his own company to continue work for the Defense Advanced Research Projects Agency (DARPA) in Systems Engineering. Pat enjoys the Geoscience News and was glad to see Erle "Lucky" Kauffman as the Twenhofel Medal recipient.

Wallace J. Cropper (MS '51) has had 12 good retirement years so far. He had been in mining geology and mineral exploration in a variety of areas for 35 years with St. Joseph Minerals Corp./ Fluor Corp. He lives in Bradenton, Florida.

Jay L. Howell (MS '51) has made the move from New Orleans to Katy, Texas, after being there for 34 years. They want to be close to family. Jay and his wife celebrated their 52nd wedding anniversary in August. They have one grandaughter 10 years old who is the apple of their eyes.

David A. Rochna (BS '58) took a few months off, after the sale of Convest Energy last fall, before joining Coastal Oil and Gas Corp. in the Technology and Business Development Department. Currently, he is having lots of fun buying and selling properties.

1960s

Susan Hershberg Adelman (BS '62) is a clinical associate professor of surgery at U-M, and recently elected to the American Medical Association (AMA) Board of Trustees. She represented the AMA on the White House Health Professionals Review Group in 1993. A few years ago Susan served as the first woman president of the Michigan State Medical Society.

John Cooper (BS '61) completed his 28th year this spring at Cal-State, Fullerton, where he teaches Historical Geology, Stratigraphy/Sedimentology, and Paleontology. For the past 25 years he has been conducting research on Neoproterozoic—Ordovician successions in the southern Great Basin/eastern Mojave Desert. John serves as managing editor for the Pacific Section SEPM and this past year was awarded a lifetime achievement award by the Society. He and his family live in an old, remodeled house that sits atop Miocene turbidites in the hills east of Los Angeles.

Darwin Spearing (PhD '69) has an expanded ranger interpretive role this year to include Joshua Tree National Park. He had a wonderful time in the spring of 1998 exploring Cretaceous monzanite intrusions and 1.7 By metamorphics in the park. OK, so how long does it take for a stack/batholith to move upward from melt zone to emplacement? This summer was Dar's sixth season at Rocky Mountain National Park. Research in national parks is sorely needed, especially in geoscience. A new research director at Rocky Mountain National Park is trying to foster university research in the park. Any interest?

1970s

Will Collier (BS '68, MS '71) has returned to Exxon in Houston, after four years with Exxon-China in Beijing. Will notes that living in China was a wonderful experience, but that it is good to be back home in the USA.

Roger L. Gilbertson (PhD '72) writes that as of September '98 they have passed their second year in Santa Cruz, Bolivia, with BHP Petroleum. They visited Machu Picchu in Peru in April and the incredible dinosaur tracks near Sucre, Bolivia, in September (as well as Cerro Rico at Potosi). BHP and their operating partner, Maxus Bohvia, Inc. continue to be the principal crude oil producers in the country (with 35% of the country's daily production, i.e., they're producing 14,600 BOPD). Roger stays in touch with Gordon Wood and George C. McIntosh.

Jeanne Sauber (BS '76) works at NASA in Greenbelt, MD, as a geophysicist, with lots of field work in Alaska. She is also editing a special volume of Pure and Applied Geophysics on the mechanics of shallow subduction. Jeanne married a math professor at the University of Maryland and they have two children, Arieh and Liora.

Barry Peter Thies (BS '71, MS '74) and his family have moved to Enid, Oklahoma, after commuting from Wichita for more than a year. He isn't sure which is more work, redoing everything in the house they bought or the work that brought him to Enid—enhanced oil recovery in Williston Basin oil fields. Barry wanted to drill horizontal wells before working for Continental Resources, Inc., and has drilled over 100 of them. It has been fun as well as a learning experience.

1980s

Sandy Ballard (MS '84, PhD '86) continues working at Sandia National Labs in Albuquerque, and in his spare time runs a high-tech startup company called HydroTechnics. Sandy has designed and produced a new instrument that meausres the full 3-dimensional groundwater flow velocity vector in saturated unconsolidated sediments.

Bryan E. Stepanek (MS '84) and his wife Rebecca proudly announce the arrival of their son Walter Scott (9/18/98), joining sisters Rachel Elizabeth (4-1/2) and Emily Claire (2-1/2). Bryan works for BP-Amoco in Aberdeen, Scotland, as a reservoir surveillance engineer following previous postings with BP in Abu Dhabi (UAE), Anchorage, and San Francisco. Bryan can be reached by e-mail at stepanbe@bp.com. The whole family has enjoyed living in Europe and the Middle East, and we look forward to new possibilities created through the merger of British Petroleum and Amoco.

1990s

Tooba Durrani (BS '91) is currently in her first year of Naturopathic Medical School. She misses geology but finds time to take field trips with the local geological society as well as attend lectures.

In Memoriam

Ruth Bachrach Curtis (MA '46) passed away June 5, 1998, in Boulder, Colorado. She taught geology for three years at Knox College. She left in 1949 to join the Continental Oil Co. in Denver. Her specialty was field geology. Ruth became an assistant to the regional geologist for Conoco's Rocky Mountain region. She also did consulting work and was a published author of several articles.

Peter C. Dooley (BS '70, MS '72) passed away in Phoenix on August 20 from pancreatic cancer. Pet had been active in the petroleum industry in Houston for many years.

William Keith Liddicoat (BS '49, MS '53), lately of Clarkston, MI, died on May 3, 1998. He is survived by his wife Eloise ("Duffy") and his brother Richard (Dick) T. Liddicoat (BS '39, MS '40) of Los Angeles. After obtaining a MS in economic geology under Prof. F.S. Turneaure, Bill worked for two years for Orinoco Mining, a subsidiary of U.S. Steel, looking for iron ore in Minnesota and Venezuela. Subsequently, he worked for Utah Construction for two years in Western Australia, also looking for iron ore. Most of his professional career (about 20 years) was spent working for the Saudi Arabian government exploring for non-petroleum resources in that country, particularly iron ore, gold and base metals. After returning to the USA upon retirement about 10 years ago, Bill and Duffy divided their time between the Lower Peninsula at Central where they bought an old mining building and converted it into a lovely home. Those who knew Bill will miss this kind and interesting person with a wonderful sense of humor.

Bruce Nesbitt (MS '75, PhD '79) drowned while on vacation at Lac Bernard, Quebec, on August 28, 1998. Bruce was a Professor in the Department of Geology, University of Alberta, Canada. He was born in Crawfordsville, Indiana, in 1951, and obtained a B.A. in Geology from Carleton College. After obtaining M.Sc. and Ph.D. degrees from Michigan, Bruce held a Postdoctoral Fellowship at Pennsylvania State University for a year. In 1980, he went to the University of Alberta, where he remained throughout his career, serving as Associate Chair of the Department from 1990 to 1993 and 1994 to 1997. Bruce's graduate program in Economic Geology at Alberta was one of the largest and most active in North America, and he was well known for his interest in large-scale fluid flow and the possibility that meteoric water penetrated into deep levels of the crust. He also served the scientific community extensively. In the Society of Economic Geologists, Bruce served on many committees, put in three productive years on the Council, and was Chair of the Nominating Committee, which selected candidates for President, Vice-President and the three Councilor posts for the 1999-2000 term. He also served as a member of the Canadian Lithoprobe Grant Selection Committee and as an Associate Editor of Economic Geology. Bruce is survived by his wife Barbara Tilley and their sons Mark and Luke, as well as by his parents, Joyce and Dan, brother Mark and sister Jane. A scholarship fund in honor of Bruce has been set up at the University of Alberta (Attn: B.E. Nesbitt Fund, Dept. of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta, Canada T6G 2E3). Books containing written remembrances of Bruce are being prepared for the boys; contributions can be sent to Bob Luth at the university address above.

Lloyd D. Owens (BS '40, MS '41), 79, retired oil geologist for the Chevron Companies, died July 9, 1998, at Prescott, Arizona, after a short illness.

Degrees Granted

PhD

Sharon Feldstein "Melting processes and the generation of chemical variability in terrestrial and extraterrestrial magmas"

James E. Silliman "Origins and diagenesis of organic compounds in freshwater and marine sediments"

Grigore Simon "Geochemistry of gold and selenium in hydrothermal ore deposits"

Peter Tropper "Experimental and field-related investigations on the metamorphic history of eclogites in the Sesia-Lanzo zone, western Alps (Italy)"

Egon Weber "Geochemical investigations of continental and hydrothermal inputs to the ocean"

Donggao Zhao "Diamonds and mantle xenoliths in kimberlites from the north China craton and the Canadian northwest territories"

MS

Boris Kiefer "Calculated elastic constants and anisotropy of Mg_2SiO_4 spinel at high pressures"

Lisa M. Kraemer "Lithology of the upper gas hydrate zone, Blake Outer Ridge: A link between diatoms, porosity, and gas hydrate"

Safarudin "Depositional patterns associated with large early Holocene lake level changes in northern Lake Michigan"

Gerd Steinle-Neumann "First-principles elastic constants for the hcp transition metals Fe, Co, and Ke at high pressure"

Faculty, Staff, and Student News

Lots of graduate students associated with **Eric Essene** have just reached milestones. **Grigore Simon** (PhD '98) defended his dissertation last spring and is working in Holland at present. **Peter Tropper** (PhD '98) and **Donggao Zhao** (PhD '98) have just completed their dissertations, and **Ed Van Hees** (PhD '98) is making the final changes in his dissertation copy. **Liping Wang** (MS '95, PhD '98?) is nearing completion of his thesis as well. Meg Streepey (PhD '01) continues structural, chronological and petrological research in the Adirondacks with Ben van der Pluijm and Eric. **Casey Donohue** (MS '99) is presenting some work on epidote-garnet oxybarometry with Eric at the fall GSA meeting in Toronto in a special symposium to honor Bob Newton. Eric Tohver (also known as ET, MS '99) is working on the thermobarometry, structural geology and chronology of Proterozoic and Archean rocks in the Upper Peninsula of Michigan.

Eric was very busy last summer with three field trips to the Adirondacks including a trip with Ben to visit Meg in the field, one to see Casey in the Wind Rivers of Wyoming, and one to the UP with Ben to see ET's field area near Marquette. Eric saw lots of rocks and had a great time in the field. He visited Camp Davis for a few days and caught some 20" cutthroats. He hopes to return to camp next summer for the next reunion! Eric also just ran another four-day field trip early this fall around Lake Huron for undergraduate non-major students with Casey's help. The weather was great, and everyone seemed to like the trip.

Dan Fisher, **David Fox**, and **Josh Trapani** just returned from a stimulating meeting of the Society of Vertebrate Paleontology. Dan and David each presented talks on their work on Pleistocene and Miocene proboscideans. One of these dealt with the complicated pattern of mineralization of mammalian tooth enamel and the implications of this for attempts to extract paleoclimate data from serial sampling of enamel. The other reported oxygen isotope data that are starting to flesh out our idea of the nature of climate change in the late Miocene of North America, when many large herbivore taxa went extinct. Josh and Dan also presented a poster on tusk microstructure and its use in diagnosing proboscidean genera. By making even isolated tusks identifiable, this greatly increases the sample available for studies of paleoclimate, human interaction, and extinction. Meanwhile, back at the ranch, mastodons were popping up in record fashion. Dan and company are now juggling three new sites, one of which has produced most of a mature male, including two ten-foot-long tusks with wonderfully clear growth increments. On the invertebrate side, Dan joined **Lindsey Leighton** and Michigan grad **Sandy Carlson** this summer to discuss higher-level brachiopod phylogeny. Lindsey and Sandy are planning further work in this area, where large-scale synthesis is badly needed. Finally, join us in raising a toast to **Paul Koch**, as he accepts the Paleontological Society's Schuchert Award at the upcoming GSA meeting in Toronto.

Steve Kesler spent most of the late spring and summer helping graduate students finish or nearly finish. **Grigore Simon** defended his PhD dissertation in June and departed for a summer of gold exploration with Homestake in eastern Europe followed by oil exploration with Shell in the Netherlands. **Ed van Hees** came back from Columbia, MO, to defend his PhD dissertation in July and departed shortly afterwards for gold exploration in Yellowknife. In September, **John Fortuna** completed most of the work for his MS degree on the causes of gold deposition at the Twin Creeks deposit in Nevada and headed for work in California. Just before leaving, John, Steve and new graduate student Zaojun Ye spent a week at the Twin Creeks and Post-Betze-Screamer gold deposits in Nevada where John presented talks on his work to geologists with Newmont Gold Co. and Barrick-Goldstrike Co., and Zaojun collected material for further research. Among the group at Newmont was Jeff Huspeni (MS '81), who is now Vice-President for Mine Geology.

Becky Lange had a wonderful experience with her first sabbatical during the Winter of 1998. Although she spent most of her time working in her lab (measuring various thermodynamic properties of silicate liquids), she also spent several weeks in the field in western Mexico, where she is working on measuring the volume and eruption rate of magmas along the volcanic arc over the last one million years. Quantitative information on the flux of magma erupted along volcanic arcs (and the variation in magmatic flux from arc to arc) is surprisingly sparse, despite its importance to models of mantle melting at arcs and the thermal and chemical evolution of continental crust. In July, Becky attended a GSA Penrose conference located in the southern Italian Alps, near the Ivrea Zone (Verbania). The theme of the meeting was "Processes of Crustal Differentiation." In February, Becky's first two graduate students defended their PhD theses: **Jean Tangeman** and **Sharon Feldstein**. Jean is now a post-doc at the University of California at Davis and is working with Professor Alex Navrotsky. Sharon just had her second child in July and has moved to Connecticut where her husband started a faculty job this Fall in Anthropology at the University of Connecticut.

Sam Mukasa had a very busy summer filled with fieldwork in Bulgaria, China and Turkey, and moving to his third office in nine months. (Those of you who have been to Ann Arbor recently will recall that the C.C. Little Building has been undergoing renovations which for the last few years have displaced faculty, staff and students one floor at a time). Sam and graduate student **Craig Carpenter** (MS '99) spent most of June doing fieldwork with **Dr. Ivan Haydoutov** (Fulbright Fellow '97–'98) of the Bulgarian Academy of Sciences in the displaced continental, oceanic,

and island arc terranes of Bulgaria and Turkey that bridge the gap between the Alpine and Himalayan mountain belts. These rocks provide an unparalleled opportunity to examine the nature and tectonic development of northern Gondwanaland during the late Precambrian and early Paleozoic because of the remarkable way in which they have been preserved, having escaped significant overprinting by the Variscan and Alpine deformational and metamorphic events. They should also reveal a great deal about the basement rocks of southern Europe prior to the Alpine event. While in the field, saber-rattling broke out all around Sam's field party with Greece and Turkey disagreeing over some islands and NATO drawing a tentative line in the sand against Yugoslavia over the current tragedies in the province of Kosovo. The field party had one narrow escape in visiting one morning the world-famous bazaar in Istanbul, which then blew up a couple of weeks later killing seven people and injuring hundreds. The last they heard, a gas leak was suspected.

After a short holiday in England and Ireland with his family, Sam headed for China to do fieldwork in Shandong Province with graduate student **Xiangyang (Helena) Xian**, and also attend the 9th International Conference on Geochronology Cosmochronology and Isotope Geology (ICOG-9) in Beijing. Sam reports that it was fascinating to see all the changes that have taken place since his last visit to China ten years before. It was most interesting to talk with people freely. While at the ICOG-9 meeting, Sam ran into some old Michigan hands like **Shun'ichi Nakai**, **John Valley** and **Torsten Vennemann**. Sam climbed the Great Wall with John and discovered that he (the latter) is in great shape.

On the service side, Sam finished his stint as chair of the Advisory Board for the Office of Polar Programs at the National Science Foundation, but then was immediately drafted to become a member of the panel for the Integrative Graduate Education and Research Training (IGERT) program. He is also the current departmental graduate advisor.

The new **Geophysics** and **Seismology Laboratories** opened for business this fall. The remodeling has changed the configuration of the lab and offices, and we also have new walls, floors, networking, and pipes. The JT Wilson Library is nicer than ever, and even the grad student offices have central air conditioning. For those that miss the "*good ol' lab*," you'll be pleased to learn that the roof still leaks! While **Chris Lynnes** (PhD '88) stopped by the new lab during his annual trek through Michigan, I know that a couple other people stopped by during the construction phase and found a battle zone instead of us. **Jean Johnson** (PhD '95) did manage to find us in our temporary quarters in the Physics building, and she continues to have fun working on tsunami projects with former professor **Kenji Satake** and teaching at a small college in Georgia. **Nazli Nomanbhoy** finished her PhD this year and stayed on as a post-doc working with **Larry Ruff** on a seismogram access web project for the IRIS Education and Outreach program. Nazli also designed the "QuakeView" web system which you can link to from the MichSeis home page ("http://www.geo.lsa.umich.edu/MichSeis/"). Just this fall, Nazli left us for a teaching position at Colorado State University. Also in the arena of educational seismology, Larry Ruff is the editor for the new EduQuakes column in Seismological Research Letters. On another front, **Richard Nolen-Hoeksema** and Larry Ruff continue to work on a project to perform moment tensor inversion on hydrofracture events, and Richard is teaching Applied Geophysics through the College of Engineering. Also, the "source time function project" is now entering its fifth year of systematic determination for large earthquakes around the world; the magnitude threshold has been lowered, and look for a significant upgrade to its web pages this winter. Perhaps the most exciting story so far this fall was the Sept. 25 earthquake (M=5.2) along the Ohio-Pennsylvania border. This event was widely felt throughout southern Michigan. We have not seen such interest from the local press since the "great" Michigan earthquake of Sept. 2, 1994. While the *MichSeis* and *OhioSeis* digital seismographs produced good-quality records that were quickly posted on the internet, it seems that we need to re-activate the old-fashioned analog drum recorders to satisfy the TV camera crews!

Ben van der Pluijm has had a productive summer that involved several field visits with graduate students. **Meg Streepey** is working in the Adirondacks on the late exhumation history with petrologist **Eric Essene** and geochronologists **Chris Hall** and **Klaus Mezger** (former U-M postdoc, now at Muenster). A similar research project was started with new graduate student **Eric Tohver** in the Marquette region of Michigan's Upper Peninsula (yes, there actually are seriously deformed rocks in Michigan), and in the southern Wind River Range with **Casey Donohue** (fieldcamp alumni may remember the Atlantic City project). **John Kollmeier** and **Arlo Weil** continue their work in the Cantabrian arc on northern Spain using calcite twinning and remagnetizations as proxies of the deformation history, respectively, in collaboration with Rob Van der Voo and Josep Pares. Josep is now officially a faculty member at Michigan, whose research interests bridge those of Rob and Ben. **Leah Joseph** just completed an ODP cruise, collecting cores off the cost of New Zealand as part of a paleoclimatology project with Dave Rea and Ben. Finally, **Yan Yonghong** has started to work on TEM characterization of clays in fault gouge, in a collaborative project with Don Peacor and Chris Hall. In addition to these graduate students, our group includes two research undergraduates, **Brita Graham** and **JR Bailey**, who work on aspects of the above projects. Ben has primarily focused on deformation characteristics of phyllosilicates this year, which resulted in a perspective on slate formation in Nature earlier this year and a discussion paper on the role of clay-bearing fault gouge with Peter Vrolijk (former U-M postdoc, now at Exxon) in an upcoming "millenium" issue of the Journal of Structural Geology. Beside these research activities and ever-increasing administrative duties in the Department and University (including the Provost's Distance Learning Committee and chairing U-M's Research Policies Committee), Ben has been involved in the development and

teaching of an interdisciplinary course on Global Change (U110). This multi-term course, currently co-taught by a team of five faculty and six GSIs from various schools and colleges, uses web-based lecture materials and laboratory exercises that cover topics from stellar evolution to building blocks of life, and natural hazards to ozone depletion and deforestation (check it out at http://www.sprl.umich.edu/GCL/index.html). In addition, Ben is part of a group of five faculty (incl. Carolina Lithgow-Bertelloni, Lars Stixrude, Rob Van der Voo and Peter van Keken) who co-teach an exciting new graduate course on Tectonophyics. Meanwhile, the soccer season is going strong. Ben has moved to coaching his youngest son's team (Robbie), while the older (Wouter) has joined the AA Soccer Association. And the leaves are yet again turning

After a year-long sabbatical at the Universities of Delft and Utrecht in the Netherlands, **Rob Van der Voo** is back half-time in the Department, with the other half of his efforts devoted to the directorship of the Honors Program in the College of Literature, Science and the Arts. The sabbatical allowed Rob to tackle some research projects new to him, involving a cooperation with Utrecht's seismologists Wim Spakman and Harmen Bijwaard. Together they have been interpreting seismic tomography results that have imaged subducted slabs under the Asian continent. A deep-mantle high P-wave velocity anomaly, visible between 1500 km depth and the core-mantle boundary under Siberia, is interpreted as the remnants of oceanic lithosphere that subducted when an ocean closed in a continent-continent collision between Siberia and the Mongolia-North China block. A separate study involved similar deeper-mantle slabs under India, interpreted as the remnants of Tethyan oceanic lithosphere subducted before India collided with Asia's southern margin in Tibet during the Early Tertiary. Presentations of these results will take place at this Fall's AGU meeting in San Francisco. Research is also continuing with **Prof. Xiao-Min Fang** (Visiting Scientist '96) and other Chinese geographers and paleoclimatologists, in a collaboration that studies the effects of changing atmospheric circulation patterns during the Quaternary in and around Tibet. Graduate students **Arlo Weil** and **John Kollmeier** are involved in research projects investigating a curved orogenic belt in northern Spain, under the joint supervision of Prof. Ben van der Pluijm, Rob, and Associate Scientist **Josep Parés**, who joined the paleomagnetism and structural geology group at Michigan this Fall. Arlo uses paleomagnetically determined directions as indicators of rotations and folding phases, whereas John is studying calcite twinning fabrics in the hope of detecting Carboniferous rotations in the same area. Graduate student **Weiming Zhou** is making excellent progress, co-directed by Rob and **Prof. Donald R. Peacor**, in a study of alteration of magnetic oxides in ocean-floor basalts. He is using an electron-microscopic technique, based on convergent-beam electron diffraction, in ways that are new to the geosciences to determine the lattice parameter and, by inference, the oxidation state of titano-maghemite grains; the ultimate goals of this project are to determine the cause of the diminishing amplitudes with age of marine magnetic anomalies and to assess the suitability of glass in ocean-floor basalts for determinations of the ancient intensity of the geomagnetic field. Graduate student **Allen McNamara** has completed his MS thesis research on latest Precambrian rocks from the Avalon Peninsula in Newfoundland, and is now pursuing a PhD degree under direction of Prof. **Peter van Keken** in geodynamics. Allen found that the Avalon terrane originated near northwest Africa in the latest Precambrian and not near the north-coast of South America as had been suggested earlier. With the administrative duties in the Honors Program, involvement in the teaching of several courses, a continuing editorship of *Earth and Planetary Science Letters*, and all these different research projects, Rob has his hands full, but is still enjoying the exciting opportunities of academic life.

Lynn Walter and her group have been dividing their research efforts between geochemical processes at work in modern forested watersheds in Northern Michigan and hydrogeochemistry of natural gas deposits. The project in northern Michigan involves the elemental and isotope budgets of carbon as they affect mineral weathering and global mass fluxes from the soil to regional groundwater systems. The project is multidisciplinary and involves faculty from Biology, School of Natural Resources, and Chemical and Environmental Engineering.

Students **Kia Baptist** and **Tim Ku**, with able assistance from undergraduate research assistant and geology major **Gabe Bowen**, have been sampling soil, ground and surface waters from the Cheboygan Watershed and conducting geochemical analyses of these samples in the Experimental and Analytical Geochemistry Laboratory (EAGL). EAGL lab manager, **John Hansen**, headed up the field water and gas well drilling effort, which yielded a complete array of field sampling sites. Lynn and **Joyce Budai** pitched in during June and July and covered field sampling while Kia and Tim went south to work as interns for Conoco in Houston and Lafayette, respectively.

Anna Martini, recent PhD and faculty member at Amherst College, took a leave of absence to put in six months of research effort with Lynn and Joyce Budai on a new natural gas play developing in the Illinois Basin. Funding provided by the Gas Research Institute, along with a number of independent gas exploration companies, was awarded to the group to pursue the hydrogeochemistry of Devonian shales in the Illinois Basin. It is hoped that these shales, age equivalents of the highly productive Antrim Shale in the Michigan Basin, will yield recoverable biogenic or thermogenic gas deposits. Anna's dissertation work focused on the Antrim Shale and determined that most of the gas was of relatively recent, biogenic origin and related to fresh water recharge of Pleistocene-age ground waters. Results so far point to a significant biogenic fraction in the gases of the neighboring Illinois Basin. Anna leaves to take up her faculty position at the close of 1998, but the project will likely continue as a joint Amherst-University of Michigan venture with the GRI.

Camp Davis Reunion-August 10-12, 1999

The Alumni Reunion at Camp Davis in Jackson Hole, Wyoming occurs only once every ten years, and the event looks to be a blockbuster–so please sign up (by sending in this form and your check) right away!

☐ Yes, I will be there for the Reunion!

☐ Number of people in your group

☐ We would like to stay in a cabin at Camp Davis

☐ We would like to stay in our RV at Camp Davis

☐ We would like to pitch our tents at Camp Davis

☐ We will be staying in a motel in Jackson*

* Please make your own reservations at the motel of your choice. The Jackson Hole Chamber of Commerce (307-733-3316) provides a comprehensive list of accommodations, available by mail.

Attendance at the Alumni Reunion will cost $50 per adult (regardless of whether you are staying in camp or in a motel). Children are free. This will cover lodging, dinner on Tuesday night (August 10), breakfast, lunch, and a BBQ dinner (the cornerstone event of the Reunion) on Wednesday night (August 11), and breakfast on Thursday, August 12. Cabins will be assigned on a first-come, first served basis, so send in your form and check quickly. Make checks payable to: The University of Michigan.

Name _____ Phone ( )_____

Address _____
Street Address

_____
City State Zip

DEPARTMENT OF GEOLOGICAL SCIENCES
The University of Michigan
2534 C. C. Little Building
Ann Arbor, MI 48109-1063

Place
Stamp
Here

CAMP DAVIS REUNION
DEPARTMENT OF GEOLOGICAL SCIENCES
The University of Michigan
2534 C. C. Little Building
Ann Arbor, MI 48109-1063

Geoalumni Information Form

Use this form to update your mailing address or to provide information to be used in the Alumni News section of the *Geoscience News*. (Please type or print)

Name _____ Phone ( ) _____

Residence Address _____
Street Address City State Zip

Business Address _____ Business Phone ( ) _____
Position Company

_____
Street Address City State Zip

e-mail address _____ would you like to be added to an alumni e-mail group? yes ☐ no ☐

Degree _____ College or University _____ Year _____

Degree _____ College or University _____ Year _____

Degree _____ College or University _____ Year _____

Spouse _____
Year of Wedding

Child _____ Child _____
Name Birth Date Name Birth Date

Child _____ Child _____
Name Birth Date Name Birth Date

Child _____ Child _____
Name Birth Date Name Birth Date

Reference Address (name and address of parents, nearest relative, or someone who will be able to reach you)

Name _____ Phone ( ) _____
Relationship

_____
Street Address City State Zip

Please send us any news of your "doings" to be included in the next newsletter; simply write below.

DEPARTMENT OF GEOLOGICAL SCIENCES
The University of Michigan
2534 C. C. Little Building
Ann Arbor, MI 48109-1063

Place
Stamp
Here

DEPARTMENT OF GEOLOGICAL SCIENCES
The University of Michigan
2534 C. C. Little Building
Ann Arbor, MI 48109-1063

Geoscience News is compiled twice a year for alumni and friends by the Department of Geological Sciences at the University of Michigan, Ann Arbor MI 48109-1063.

Phone: (313) 764-1435

e-mail: geo.alum@umich.edu

Editors: H. N. Pollack and K. C. Lohmann

DEPARTMENT OF GEOLOGICAL SCIENCES
The University of Michigan
2534 C. C. Little Building
Ann Arbor, MI 48109-1063

First Class

Address Correction and
Forwarding Requested