

GEOSCIENCE NEWS

*for alumni and friends of the
Department of Geological Sciences
The University of Michigan, Ann Arbor, Michigan*



June 1994



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Greetings from the Chair

This week the dust starts flying again in the Department as our C.C.Little renovation gets underway. The infrastructure improvement (planned for 1994-1996) will include new windows, heating, air-conditioning machinery, some plumbing and electrical renovations, roof repair and a new elevator. Remember the tiny, tiny elevator opposite the loading-dock entrance that was supposed to hold thirteen people? It will be taken out of service. We still hope that parts of the first, third and fifth floor are included in some additional renovation, but the final decision has not been made at the time of writing, because of budgeting uncertainties.

We will also be involved next year in another major activity. The University arranges for external review of departments on a regular basis. It recently discovered that Geological Sciences had not been reviewed, ever, and so asked us as a first step to prepare a self-study by early-middle 1995 in which we document our successes (many!), failures (few?), and aspirations (high). A visiting committee of some three or four earth scientists will then be invited to visit and to present a written evaluation in response to a "charge" composed by the Dean that poses insightful questions about the Department. Steve Kesler, Dave Rea and Ben van der Pluijm have agreed to prepare the self-study in the coming year. So dust will fly in more ways than one!

All over the country public universities are seeing their state allocations remaining flat or actually declining, and the University of Michigan is no exception. Given that other sources of university General Fund income (tuition, indirect cost on grants) cannot be increased beyond reasonable limits, the University has begun a process of budget retrenchment in

all units, and Geology has been asked to plan for a 10% reduction over the coming five years. This likely will mean that the size of the faculty and staff will shrink gradually by some 10%, starting with a loss of a position when Bill Kelly retires this summer, in addition to other reductions that will limit our financial flexibility. The Department learned with much regret late last fall that Mike Gurnis had decided to accept a position at the California Institute of Technology, but we are busy trying to find a way to persuade the University that we need to keep the faculty expertise of his position maintained in the Department. We wish Mike well in his new situation, but are sorry to see him return to earthquake "paradise" (could it be that the Loma Prieta quake in 1989 and the Northridge/Los Angeles quake in 1994 were "welcome back" events for Thorne Lay and Mike, respectively?). In the meantime, until the dust of retrenchment settles, we are searching to fill Mike's position with a visiting assistant professor who has the courage to brave Michigan's climate and is less charmed by earth-shaking or burning lotus blossoms than our former colleagues.

A well-known Chinese curse goes "May you live in interesting times." Are our times interesting yet?

Sincerely,



Rob Van der Voo
Chairman

The 1994 Dorr Lecture

On March 25, **Cathryn Newton**, who is Chair and Professor at Syracuse University, gave the annual John A. Dorr Jr. Memorial Lecture on "Mesozoic Extinctions." The very interesting lecture was followed by a banquet at a local restaurant, where our speaker and her husband, faculty, students, Ruth and Robyn Dorr all had a chance to engage in further discussions. The John A. Dorr Memorial Graduate Student Award was presented to **Joe Graney** for his environmental geology research. The lecture and student award are made possible by an endowment fund established by the Dorr family.

On The Cover

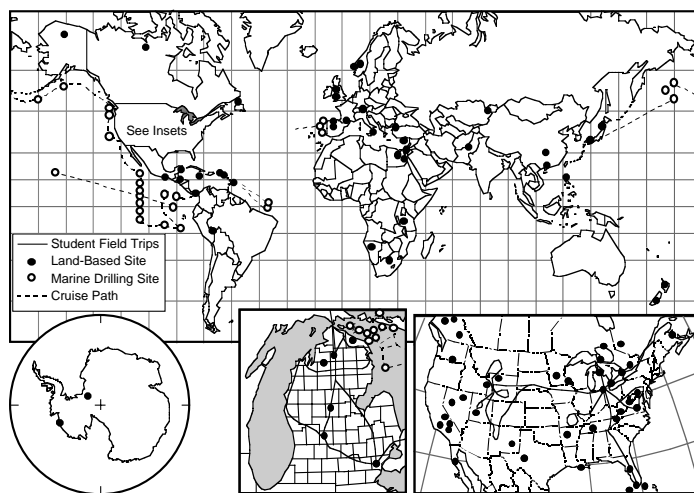
A photograph of Field Geology students at Camp Davis in **1885**. Provided by John Sherzer of Ann Arbor, whose grandfather William H. Sherzer taught at Camp Davis. The department would love to hear from anyone who can shed some light on the names of these people.

Is Field Work Obsolete???

Is field work obsolete? Have our analytical labs and theoretical simulations become so sophisticated that we don't need to go to the field anymore?

This question is not new. It has been asked by successive generations of geologists for the past century. And the answer is always NO, NO, NO. In fact, the growth of laboratory methods requires **more** field work rather than less. Lab and theoretical studies can ascribe new importance to old textures or features that might have been ignored in earlier studies. New developments can permit analyses that were not even possible a decade ago, requiring a new look at old field areas. As a result, most Michigan faculty and students come and go regularly from the field on behalf of their research.

As you can see on the map, **Michigan Geology** is represented



throughout the globe, both on land and at sea. Locations shown here for field work and field trips are for only the last few years and do not include important projects, such as the heat-flow studies that sent students roaming throughout Africa and South America, or the numerous studies of Mexican carbonates, xenoliths, volcanoes and ore deposits.

Land-based field work varies from short sampling trips to mapping exercises of much longer duration. Most work is concentrated in the U.S., although projects are underway in a total of 25 countries at present. Some field-based efforts have been going on for over a decade and have involved a large number of students and faculty. Among these are metamorphic and structural work in the Grenville province, terrane studies in the northern Appalachians, work on MVT deposits in the Appalachians, carbonate-related studies in the Bahamas Bank, southern Florida and the Permian basin, and vertebrate paleontology surveys in the Big Horn Basin. Several large projects have been carried out in Michigan, including mastodon exca-

vations in Calhoun County, the Antrim shale-natural gas project in the northern part of the Lower Peninsula and the Keweenaw-White Pine project in the Upper Peninsula. Foreign field projects include geoarcheological work and whale studies in the eastern desert of Egypt, petrologic work in the Philippines, tsunami studies in Nicaragua and Japan, paleomagnetic surveys in central Africa and Guanaxi Province, China, petrologic work along the Cameroon line, and ore deposit studies in Honduras, Namibia and South Africa. Despite the remoteness of many of these field locations, the award for most difficult field setting goes to the Antarctic effort. The most recent of these continuing projects, a study of the Dufek layered igneous complex, is remote even by Antarctic standards, requiring a 700-mile flight from the base of operations and work at high altitude.

Oceanographic work is just as widespread, with Michigan representation on at least six major cruises between 1991 and 1993. These cruises involve several types of remote sensing and drilling, including deep ocean drilling, an impressively difficult process that requires constant attention and flexibility on the part of researchers attempting to obtain useful samples. Recent projects have involved the late Cretaceous tectonic evolution of the North Pacific, geochemistry of ferromanganese nodules and hydrothermal deposits, eolian dust records and paleoclimate, and organic geochemical evidence of paleoenvironmental cycles. Cruises have also been carried out in the Great Lakes, with the most recent work on the paleoclimate history of northern Lake Huron. (In case you are wondering who is doing all of this work, stay tuned. We expect to have more detailed reports on specific projects in the near future.)

In addition to research-related field activities, the tradition of student field trips continues as strong as ever. Michigan undergrads can go on several course-related field trips, begin-



Vicki Hover, Tim Lyons, and Bob Klein (l-r) sampling carbonate mud in the Florida keys during a recent trip with Lynn Walter.

ning with the annual Bancroft mineralogy trip. This is followed by a series of trips around the Lower Peninsula and adjacent Ontario in sedimentary geology. Then comes the annual petrology field trip. After the core courses are completed, students go on to Field Camp where they stay in the field for most of two months. When they get back to school for their final year, there are the field trips in advanced courses on petrology, economic geology, Quaternary geology, soils, sedimentary geology, and structural geology. Some time along the way, most students also go on a trip to see the polished rocks on buildings around campus and Main Street.

It is not easy to keep up the pace of field work. Undergrads have to miss classes in other departments. Grad students and faculty have to cover for each other to avoid missed classes. And, it all costs money, which must be raised in an increasingly difficult funding arena. It is, indeed, easier to stay home and work on samples from the last trip or test a computer model, but the urge

to see new rocks continues to be a strong driving force for the Department. Thus, as the summer rolls around again, offices and labs are closing down and coffee is left to cool, as most of us go back to see the rocks that got us into this business to begin with.

The Campaign for Michigan

by John Joity (BS '71, MS '73)

The University of Michigan is now midway in its very ambitious capital campaign, The Campaign for Michigan, which has a target of \$1 billion over five years. At the halfway mark gifts have reached the \$580 million level. The Department of Geological Sciences launched its component of the campaign last fall. The Department goal of \$5 million is likewise very ambitious, especially at a time when the energy and resource industries continue to experience periods of downsizing. Special initiatives identified for targeted support through the end of the decade include a field excursion fund, student scholarships, Camp Davis, and laboratory technical support. These and other important targets are described more fully on the following page. I am very pleased to report that as of press time for this Newsletter, the Department has received pledges of \$100,000 for undergraduate scholarships, \$50,000 in support of the stable isotope geochemistry lab, a bequest of \$20,000 to assist activities in mineralogy and economic geology, and other gifts totalling \$230,000. What a great start!

Last November we sent you in the mail a special video about the Department. This video, entitled "A Tradition of Leadership" and produced by two U-M graduates as a special gift to the Department, is an extraordinary statement about the vitality of the geological sciences at Michigan. I hope it inspires your continued and enthusiastic support of the Department as we move forward to the 21st century. If you have been an annual contributor, let me say how grateful we are for your continuing support. If you are a first time contributor, welcome to the large family of supporting alumni. We hope you will take pleasure in seeing your gift at work in the years to come. In addition to sitting down and writing a check, there are many other ways to help the Department that you may wish to consider. Pledges over several years, bequests, trusts, and gifts of appreciated property have flexibility and tax benefits that may be attractive to you. Please drop a note to the Department if you would like to learn more about some of these alternative ways of giving. No matter how you elect to help the Department, please be assured that every gift, large and small, is received with gratitude and will be utilized with great care. On behalf of the Alumni Advisory Board and the students and faculty of the Department, let me thank you in advance for your generous support of our "Tradition of Leadership." (John Joity is Chairman of the Alumni Advisory Board)



Teige Davidson (l) along with two students from the university of new Hampshire in front of a cinder cone at Craters of the Moon, Idaho during the regional field trip from Camp Davis led by Becky Lange.



Sam Mukasa at the South Pole. Research doesn't get much further into the field than this.

Department of Geological Sciences

Capital Campaign Targets

Field Excursion Fund

Field investigations are at the very heart of the geological sciences, and no experience in the classroom, lecture hall or laboratory can substitute for activities in the field. Excursions from Ann Arbor in recent years have included stratigraphy and sedimentology trips to the Florida keys and the Yucatan peninsula to study modern carbonate environments, to west Texas to study the Permian reef and evaporites, and a structural/stratigraphic traverse across the central and southern Appalachians. However, because of economic constraints we have been forced to schedule some trips on an alternate year basis and to ask the students to pay an ever larger part of the trip expenses. The field excursion fund would permit us to mount field activity at a level dictated by educational needs instead of economics.

Field Fund Annual Expenditure: \$20,000 Endowment Goal: \$400,000

Visiting Lecture Series

Part of the vitality of any academic department derives from the stream of weekly visitors who present a lecture or seminar to the faculty and students, and interact with them for a day or two in informal ways. The exchange is truly bi-directional: the department becomes better acquainted with the visitors' teaching and research activities, and the visitors learn of the educational philosophy, scientific activity and research facilities of the department.

Visiting Lecture Series Annual Expenditure: \$20,000 Endowment Goal: \$400,000

Camp Davis: Instructional Technology and Infrastructure

Field training remains integral to the education of all geologists. While the structure and stratigraphy may not change, the tools for mapping and analysis certainly have. We need to bring field instruction into the 21st century with satellite global positioning systems, CB radios, portable directional range finders, and classroom computers with graphics capabilities. In addition, the camp facilities, from the mess-hall to the classrooms to the cabins, are aging and in need of significant renovation.

Camp Davis Capital Investment Goal: \$200,000

Student Fellowships and Scholarships

Graduate education and training is one of the central functions of a research university. Virtually all graduate students in Geological Sciences at the University of Michigan go on to productive careers in industry, government and colleges and universities. The present annual cost per graduate student (tuition plus academic year stipend) at the University of Michigan is approximately \$22,000; the total expenditure for Geological Sciences graduate students in 1993-94 will be in excess of \$1,500,000. At the undergraduate level it is a well known fact that interest in scientific careers has steadily declined for over two decades. Undergraduate scholarships will enable us to attract the very best students into earth science careers before they make commitments to other majors.

Fellowships-Scholarships Annual Expenditure: \$75,000 Endowment Goal: \$1,500,000

Research Initiation Fund

The purpose of this fund is to provide seed money for the initial stages of research projects at a time when external funding is difficult to attract. Our experience has shown that preliminary results acquired with seed funding often open the door to substantial funding of the project by the National Science Foundation or industrial sponsors. In practice, a sizeable fraction of the seed funding provides summer support for graduate students working on the new projects. The very modest funds we presently have for this purpose (about \$35,000 annually from the Scott Turner bequest) are awarded in an annual competition in which both students and faculty submit proposals for evaluation. We envision a similar competition for the Research Initiation Fund awards.

Research Initiation Fund Annual Expenditure: \$50,000 Endowment Goal: \$1,000,000

Information Technology Fund

Central to any modern scientific research endeavor is the ability to acquire, store, retrieve, manipulate, display and analyze data with computers. Additionally, the power of modern information technology is amplified through transparent local and global networking, whereby information can be shared and teamwork promoted. It is imperative that the Department have the resources to take advantage of the rapidly evolving information technology that is revolutionizing the way geologists utilize geological information.

Information Technology Fund Annual Expenditure: \$25,000 Endowment Goal: \$500,000

Laboratory Technical Support

The growth in both number and sophistication of the Department's research laboratories have strained our ability to provide necessary technical support, adequate training for students, and financial subsidies of student usage. The Mitchell Endowment of the Electron Microbeam Analysis Laboratory in 1986 set a standard for all other laboratories in the Department by enabling that important facility to provide services to all students and faculty. We seek to develop a similar endowment base for each of the major laboratories in the Department.

Technical Support Annual Expenditure: \$50,000 Endowment Goal: \$1,000,000

Contributors to the Geological Sciences Campaign for Michigan (1993-94)

Individual

Norbert L. Archbold
Scott Baird
Giulio G. Baldrighi
Frank M. Barnes
William M. Barnes
William S. Bartels
Robert A. Basse
Barbara and Julius Beers
Catherine D. Belknap
Richard W. Benner
William B. Borrmann
William H. Boyer
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Thomas Brocher and Anne Okubo
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Chris D. Brotherhood
Roger Brown and Den Carty
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Strength Through Unity

by John J. Amoruso (MS '57)

(Editor's note: John Amoruso is President of Amoruso Petroleum Co. in Houston, a former member of the Department's Alumni Advisory Board, and President of the Executive Committee of the American Geological Institute. This commentary originally appeared in the February 1994 GEOTIMES and has been adapted for Geoscience News with permission of the American Geological Institute.)

The Greek writer Aesop had it right almost 2500 years ago when he wrote "The Bundle of Sticks." A single stick will break easily, but a bundle of sticks withstands all attempts at breakage. In the fable, the father imparted his wisdom to his sons that there is strength in being together. But once you quarrel and are separated, you are easily destroyed.

The ancient Romans understood this principle in their masterful management of one of the largest and most successful empires the world has ever known. As a symbol of unity and strength they used the fasces, a bundle of rods bound around the handle of an axe. The wisdom and the symbol have been appropriated in modern times by the government of the United States, which incorporated the fasces into the design of its winged Liberty dime (minted through 1945). Strength through unity has provided the blueprint for success throughout history, and the same formula will ensure the successful future of the earth sciences.

The spirit of unity was demonstrated at the Summit Meeting of Presidents and Executive Directors of Earth Science Societies, co-sponsored by the Board on Earth Sciences & Resources of the National Research Council and the American Geological Institute. The meeting was held on November 30, 1993, in Washington, D.C., with representatives from 30 geoscience organizations, including professional societies and federal agencies. The meeting focused on government affairs and public policy programs conducted by the earth science community. The answers and comments from the representatives were strong, clear, and consistent to such questions as these: Are the programs appropriate? Are they effective? How can they be improved?

Not only is it appropriate to energetically express our opinions to government and the public, it is essential in today's world. Legislation, regulation, the awarding of grants and the funding of education and research programs heavily impact all the sciences, but particularly so the earth sciences. If we want the earth sciences to advance and prosper, we must be effective in influencing those actions and policies which promote that goal. The common message of the panelists was that if the earth science community does not speak out on issues within its purview, governmental and public policy decisions will be made without adequate information. Expediency will take the place of experience, and decisions affecting the future of the earth sciences will be made by people who have little or no knowledge of the science. Worse yet, the decisions might be made by people with private agendas that are destructive to the science. Paraphrasing one of the speakers: "If you don't do it, it will be done for you. You may not like the result, but I guarantee that it will get done." That little piece of reality should galvanize us all into unity. Remember the cartoon of the horse whose equipment was designed by a government committee? We need to do better than that for the earth science community.

The key to making the earth science community more effective on issues that concern the science and the profession is to present positive and scientifically sound comments and proposals on the matters that affect us all. This objective can only be accomplished through the cooperation and coordination of the various societies. Trying to get the job done alone is like the single stick in Aesop's fable. By joining together in a unified effort we can accomplish almost anything. This is where the American Geological Institute serves a vital function, coordinating and focusing cooperation.

The joining together in a unified effort, which we must do on a science-wide scale, has already worked at the personal level for our Department. In the last decade, departmental ranking has risen from twenty-first to sixth in the nation, according to the *U.S. News and World Report's* analysis of geoscience departments. This success is an accolade to the faculty, the staff, the corporations which have provided funds, the loyal alumni who have generously supported departmental programs and the University as a whole. Working together does indeed produce results.

Our energetic faculty will continue to strengthen the Department, but they will need our cooperation and support in the form of financial resources. Let's show our unity by providing the finances necessary for progress, and keep Aesop's principle working for us.

Alumni News

1930's

Albert B. Carlisle (BS '38) writes from Port Huron MI that he is still active in the oil and gas business 55 years after his graduation from U-M.

1940's

Lloyd D. Owens (MS '41) is happy to learn that Camp Davis is still active. He says that so few of the recent graduates and new hires get to see rocks.

R. David Matthews (AB '43) is the author of a chapter in recently published U.S. Geological Survey Bulletin 1909, *Petroleum Geology of the Devonian and Mississippian Black Shales of Eastern North America*. The chapter, "Review and Revision of the Devonian-Mississippian Stratigraphy in the Michigan Basin" is the result of Dave's continuing involvement with the Antrim Shale since 1956. Chapter D includes a compilation of the work of other investigators and, in particular, the results of subcontracted studies that were a part of the Dow Chemical/Dept. of Energy Antrim Shale project from 1976 to 1980. After 28 years with Dow Chemical Company (and Brazos Oil and Gas Co.) Dave retired as District Geologist. As Senior Geologist (1980-85) with the Institute of Gas Technology in Chicago, he worked primarily with the eastern black shales and other oil shales. Since 1985 he has maintained a consulting practice (R.D. Matthews Inc., 1340 N. Astor St., Ste. 2601, Chicago IL) and a continuing interest in the economic potential of the black shales.

Linus R. Litsey (MS '47) retired in April 1991 from Scientific Software-Intercomp. He is involved in part-time consulting in geology and petrophysics in the petroleum industry—much of it overseas, last year in Argentina and Colombia.

Stratton H. Bull (BS '48, MS '49) writes from Natchez MS that since graduation he has worked for a major oil company (Chevron); a large independent (Murphy); a small independent, and for approximately 13 years as an independent. He is essentially retired since the oil business died, as far as independents go.

1950's

Ann Coe Christiansen (BA '50) retired from the USGS in August 1990 after 37 years, 16 of which were as Denver Geologic Map Editor and another 14 years in association

with J. David Love on the geologic map of Wyoming and other publications on Wyoming. She is building a house that faces north to the continental divide on the edge of the San Juan Mountains.

Max F. Hentz (BS '50, MS '52) retired from the petroleum industry in 1986 after spending 33 years as a petroleum geologist and having worked 22 years in foreign exploration in Venezuela, Spain, Indonesia, Libya, Singapor, Japan, Gabon Africa and Australia. He is presently enjoying retired life though still keeping his fingers in the petroleum business, mainly in foreign areas.

William J. Malin (BS '50, MS '52) has made the decision with his cohorts to shut down their company (Independent Energy Corp.) because of the extremely low level of oil exploration in the U.S. Thus, he is finally retired at age 67 and so far is enjoying it.

Earl E. Brabb (MS '52) writes that most of his activities involve the completion of the geology of the southern San Francisco Bay region before retirement from the USGS in September 1994, and the publication of papers involving the use of GIS in preparing earthquake and landslide hazard maps. He toured landslide areas in the Czech and Slovak Republics last fall and gave a paper on a worldwide landslide mapping proposal. Then he went to Italy to give a paper on the successes they have had in using hazard maps for San Mateo County near San Francisco to reduce the density of development permitted in geologically hazardous areas. He publishes a newsletter on landslide research to keep in contact with kindred souls in many countries. He lectured in universities across the US, including Michigan State, on a trip to his 45th HS reunion in Grosse Pointe. Spain beckons, too, and he is scheduled to give a hazards course at Granada University. He is having a busy and interesting life.

William W. Easton (MS '52) had shoulder surgery because of an injury sustained while kayaking on the Pigeon River, south of Mackinaw City. He has been involved in archaeological digs at Ft. Michilimackinac and Superior National Forest in Minnesota, and visited important archaeological sites in Thunder Bay, Ontario, and Montreal, Quebec. He travelled to the canyon lands area of Colorado, Utah, and Arizona where he relived his days as a uranium geologist about 40 years ago with the USAEC. While visiting the Hawaiian Islands, he had a heart attack and triple bypass surgery; he is recovering nicely.

Lance Erickson (BS '56, MS '57) writes that he continues to appreciate the news and information he receives from the department. He has many fond memories of his years here in Geology and many relate to his interaction with faculty and teaching fellows, e.g. Professors Dorr, Eschman, Goddard,

and especially Chuck Hewitt, a TA who gave good counsel and was a caring and helpful mentor.

John Amoruso (MS '57) is the 1994 President of the AGI Executive Committee. (Be sure to see John's article, "Strength Through Unity," above, as modified from his recent *Geotimes* article.)

Haig F. Kasabach (MS '59), working with the New Jersey Geological Survey, is now the Statistician for the Association of American State Geologists.

1960's

Holmes A. Semken (PhD '65), University of Iowa, is the Secretary of the AGI Executive Committee for 1994.

Raymond M. Coveney, Jr. (MS '69, PhD '72) returned to the Department of Geosciences at the Univ. of Missouri in Kansas City in the fall of 1993 after an 18-month stint as Interim Dean of the College of Arts and Sciences. Ray has begun a three-year term as a councilor for the Society of Economic Geologists.

1970's

Roger L. Gilbertson (PhD '72) writes from Buenos Aires that his natural gas discovery in the Nenguen Basin looks very good. He is also doing exploration on a block in the Cuyo Basin (seismic acquisition, geochemistry, etc.). The famous "oldest dinosaur—*Eoraptor*" locality is on this block. Roger is also trying to locate a collecting site on the block that has abundant Devonian crinoids—maybe he'll entice George McIntosh to visit Argentina yet! He wishes everyone the best in '94.

William W. Montgomery (BS '75) is back in Michigan after being away from the midwest for 15 years. Early retirement from the oil patch has allowed him to do something he's been wanting to do for a long time—earn a PhD in Geology. He is pursuing the program at Western Michigan University, which emphasizes hydrogeology, and has it on good authority from sources within UM that this is a good program. He is teaching a 300-seat intro. oceanography lecture, which is hard work but rewarding (some may remember him doing well entertaining captive audiences, like those in the vans at Camp Davis...). If all else fails, he still has rock and roll to fall back on, which he is still pursuing (20+ years now) with frat brothers from UM. He has a couple of new fans now, too, in the form of Katie (10) and Evan (8), both of whom are musical and LOUD. Their mom (Marcia) is a real saint, as well as hard of hearing. Bill is glad to be back and closer to family, friends, and real winter, but thinks we could do with a little less snow. He is hoping to see his old friends soon.

Paula (Peterson) Thurston (BS '77) is a not-so-silent partner of Thurston Testing Laboratory in Elko NV. TTL does construction testing—soils, concrete, asphalt, and some environmental applications. She keeps busy with the breeding and raising of registered dairy goats.

Kathryn S. Makeig (BS '73, MS '78) opened up her own environmental consulting business in November 1993.

Nora Foley (BS '78), husband Robert, and sons Rob and Nick welcomed a new member to the family. Emily Kate Ayuso was born on May 4, 1993. Nora continues her work at the USGS in Reston VA and was named an Associate Editor for *Economic Geology* in April. The whole family was in Ann Arbor this summer to celebrate Nora's younger sister Eileen's graduation from UM Medical School in June. Also she enjoyed seeing many fine presentations at Boston GSA from UM alumni, professors, and students.

1980's

Susanne Janecke and **Jim Evans** (both BS '81) are very happy to announce the birth of their daughter Erica Sarah Janecke Evans on November 29, 1993, who "is cute as a button." The family is doing well.

Nat Usher (BS '82) writes that they moved from Dallas to Houston two years ago, then Dallas goes and gets a hockey team! Most of his work efforts involve engineering geophysics and marine geohazard mapping. Nowadays everyone must wear many hats, so he also dabbles in seismic data acquisition, borehole seismics, environmental, and safety. After work he brews beer and drinks home-brew, the ultimate past-time. Last summer he enjoyed a visit from fellow "alum" Rick Webb and family, who hasn't changed except for the chin whiskers. Nat would like to announce the safe arrival of child No. 3, Mary Emily, on 3/10/94, and he thinks that he now knows what causes this. He wishes everyone to "Live Long and Prosper."

Christina B. Behr-Andres (BS '84) is proud to announce the birth of a son, Joseph, on September 28, 1993.

Joy Chen (MS '85) married Eddie Kwong (a graduate of UCLA's business school) in November 1992 and is now living in southern California. Eddie works as a division manager in the leisure time/recreation industry. Joy currently works part-time as a geologist with Engineering-Science, Inc., an environmental consulting company based in Pasadena, CA. In addition, the couple runs a business out of their home, selling custom-made gift baskets and Christian books, gifts, and church supplies. Although both are native southern Californians, Joy misses Ann Arbor and has been trying to convince Eddie that a vacation in Michigan would be quite rewarding.

Sarah (Ra) Eldredge Trautwein (MS '85) and husband John are the proud parents of John Luke Trautwein (6 lbs, 8 oz), as can be seen in the accompanying photo. Ra works for British Petroleum in Anchorage.



1990's

Dongwoo Suk (PhD '92) writes from Seoul, Korea, that he is employed by the Department of Geology at Yonsei University. He sends greetings.

Rob Van der Voo Awarded Thurnau Professorship

We are delighted to announce that Rob Van der Voo has been named to the University of Michigan Thurnau Professorship in recognition of his inspiring leadership in reform of undergraduate education, not only in the Department, but in the University as a whole.

Even while carrying on with his Chairman's duties, Rob has continued to carry a heavy teaching load, consistently ranking among the top group of instructors in our Department. Rob's quality as an instructor places him among the excellent instructors at the University of Michigan. But what makes Rob's contributions so special is that he has taken the improvement of the undergraduate experience as a major

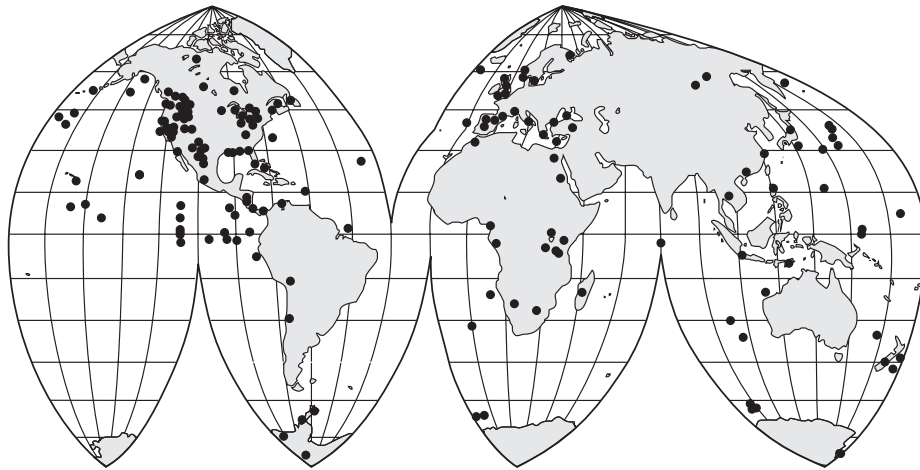


goal both in his capacity as Chair of the Department (from 1981-1987 and 1991-present) and as an individual professor. For example, recently (1990) he submitted a proposal to the National Science Foundation for support of a new undergraduate teaching initiative in Geology and Astronomy. Under this initiative most faculty members in the Geological Sciences and several in Astronomy will teach seminars that encourage close interaction between instructor and students. The approach taken in these small classes (less than 20 students) concentrates on the involvement of undergraduate students that would otherwise avoid science courses. This proposal was funded and several of our faculty are teaching such seminars each year. In addition, Rob took upon himself the task to lead weekly meetings in the Department for Faculty and other interested parties (graduates, undergraduates) on the topic of teaching. In these meetings avenues to improve undergraduate teaching are discussed as well as the role of science teaching in college education. Both the seminar and the weekly meeting were fully embraced by the Faculty and now exist in our regular teaching schedule. In addition to this specific initiative, Rob mandated a broad examination of the undergraduate curriculum in geology and encouraged the introduction of several new courses that reach out to the changing demands in today's society. Several of these courses have already proven to be successful toward this goal. The leading and visionary role of Rob in these initiatives cannot be overemphasized. He stood at the root of many of the ideas and continues to be deeply involved with their implementation and execution.

Rob has also made important contributions to the University's recent undergraduate initiatives. As a member of both CCUE and PCUE he has proposed and pursued fundamental improvements to the teaching structure at Michigan. Perhaps most significant is his proposal of, as it was called at the time, the Athenaeum, where students interact closely with professors outside their first field of interest, relatively early in their career. The Geology seminar initiative mentioned above served as the model for the Gateway seminars that will be offered to all incoming students of the College.

Rob's contributions have received recognition both from within the College and the University. For the last three consecutive years (1991, 1992, 1993) Rob has received the LS&A Excellence in Education award. Previously, Rob received the Distinguished Faculty Achievement Award (1990) and the Henry Russel Award (1976) of the University of Michigan. There is certainly no person in our Department and perhaps in the University more deserving of the honor of a Thurnau Professorship than Rob Van der Voo. Receiving this honor rewards Rob's continuing dedication to improving the undergraduate experience at the University of Michigan and his passion as a classroom teacher.

**University of Michigan
Department of Geological Sciences
1994**



What Do These Places Have In Common?

New Department T-Shirt

Department students have produced a new t-shirt for the first time in several years. A contest was held this spring to select a design. The winner, one of ten entries, has a world map on the front with nearly 100 red dots marking sites where field work has been done by current students. The caption reads "What do these places have in common?" The back of the shirt answers the question with "Been there, done that, sampled it!", and lists the places names. The shirts are 100% cotton Hanes Beefy-T's and are offered in five colors (long sleeve in white only). Show your Michigan pride and support Geology Club activities—order one today!

Sizes: S, M, L, XL, XXL; also youth size 6-8

Colors: White, Stonewash Blue, Stonewash Green, Natural, Ash Grey (long sleeve in white only, youth size in light blue only)

Prices: Short sleeve t's; \$11, Long sleeve; \$12, XXL; \$1 add'l, Youth; \$10

<i>Color</i>	<i>Number</i>	<i>Size</i>	<i>Long Sleeve?</i>
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Name: _____

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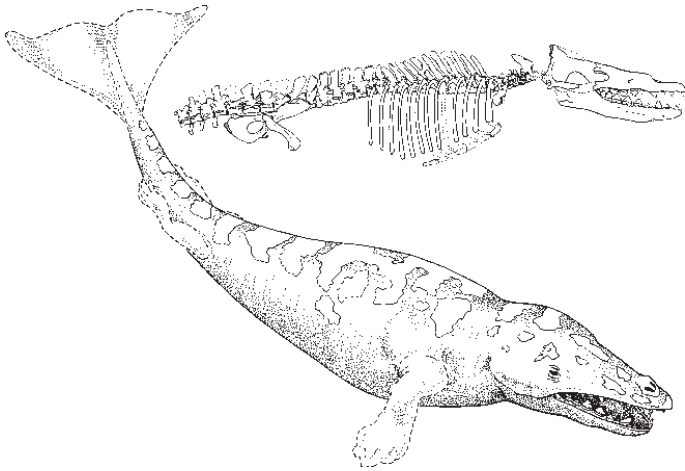
Number of t-shirts ordered: _____ Total Payment: _____

Return this form with payment to the U of M Geology Club, 2534 C.C. Little, Ann Arbor MI 48109-1063.
Make checks payable to: Geology Club.

Chance and Opportunity in the Evolution of Whales

by Philip Gingerich

Evolution is a lot like science: both are competitive to some degree, both are often repetitive, and both depend on chance for opportunity and progress. In science we often hear that chance favors the prepared mind. But no matter how prepared our minds might be, we can only really expect what we already know, and progress comes hand-in-hand with surprise. Evolution depends on chance, and it is fundamentally opportunistic, too.



I first became interested in fossil whales by accident while leading a field expedition in Pakistan. In 1978 we found the skull of a mammal not much larger than a wolf. The skull was found in continental red beds with an early Eocene land-mammal fauna (about 50 million years old), and it proved to be an archaic cetacean or whale older than all others. It had an unusual ear with a dense “bulla” required for hearing in water, but without the separation of left and right bullae present in later whales that enables them to hear directionally. We named this whale *Pakicetus*, and speculatively reconstructed it with fore and hind legs on the cover of *Science*.

Marine Eocene whales were collected in Egypt at the turn of the century, but surprisingly no one followed up on the potential here until we started in the 1980s. At the very end

of our 1989 expedition I found a small 20cm long femur or thigh bone associated with a 16m long middle-to-late Eocene skeleton of the whale *Basilosaurus*. This showed, to our complete surprise, that this huge creature still had a knee, and it showed where on the long skeleton to look for more. In the last days of the field season we managed to find the lower leg and foot, complete with toes. The legs are much too small to have supported such a large whale, but they are important in showing that legs and feet were still present 10 million years after whales entered the sea. The transition from land to sea took a long time, and to me this meant that we should be able to find intermediates in the stratigraphic record.

I went to Pakistan in January 1991 (flying through Riyadh as the Gulf War was about to begin) to set up a new project to look for intermediates between *Pakicetus* and *Basilosaurus*. Hans Thewissen received his Ph.D. in vertebrate paleontology here in 1989 and now teaches anatomy at Northeastern Ohio College of Medicine. Hans has been working in Pakistan, too, collecting land mammals and finding new *Pakicetus* remains in northern Punjab. Now he got lucky. Early in 1992 Hans found the partial skeleton of a 48-49 million year old whale with large hands and feet that is wonderfully intermediate in time and form between *Pakicetus* and later whales like *Basilosaurus*. Hans named this *Ambulocetus* (see January 14 *Science*).

Late in 1992 I spent a month in southwestern Punjab with graduate student Xiaoyuan Zhou. Xiaoyuan is writing his dissertation on the land mammals, called mesonychids, that gave rise to whales. Chance favored us, too. Our best find is the 46-47 million year old skeleton shown here, which was recently described and named *Rodhocetus* (see April 28 *Nature*). The reconstruction is adapted from one by Michael Rothman in the *New York Times*. Ours is easily the most complete skeleton of an early whale. It lacks hands and feet (which we presume were stolen by sharks when the animal died) and has a more reduced femur, but the new skeleton complements Hans’ find in many ways. *Rodhocetus* shows that swimming with a powerful tail evolved early in whale history.

I have mentioned surprise, accident, chance, and luck here in describing how four important stages of whale evolution were found. In the process, we have changed what we know about early whales and hence what we expect to find in the future. John Noble Wilford of the *New York Times* recently asked *why* land mammals went into the sea to become whales? The answer is easy: opportunity. Foxes patrol cracked ice along the shore of Lake Michigan in winter, looking for dead fish. The Tethys Sea that covered Pakistan in the Eocene was warm but full of fish, and the chance opportunity first to find dead fish along the shore and then to chase and eat live fish in the water is surely what started the transition to whales. Mesonychids must have been surprised at their good fortune, and they probably knew that accident, chance, and luck were all involved!

Alumnus Profile

The DELMARVA Study: Assessing Regional Water Quality

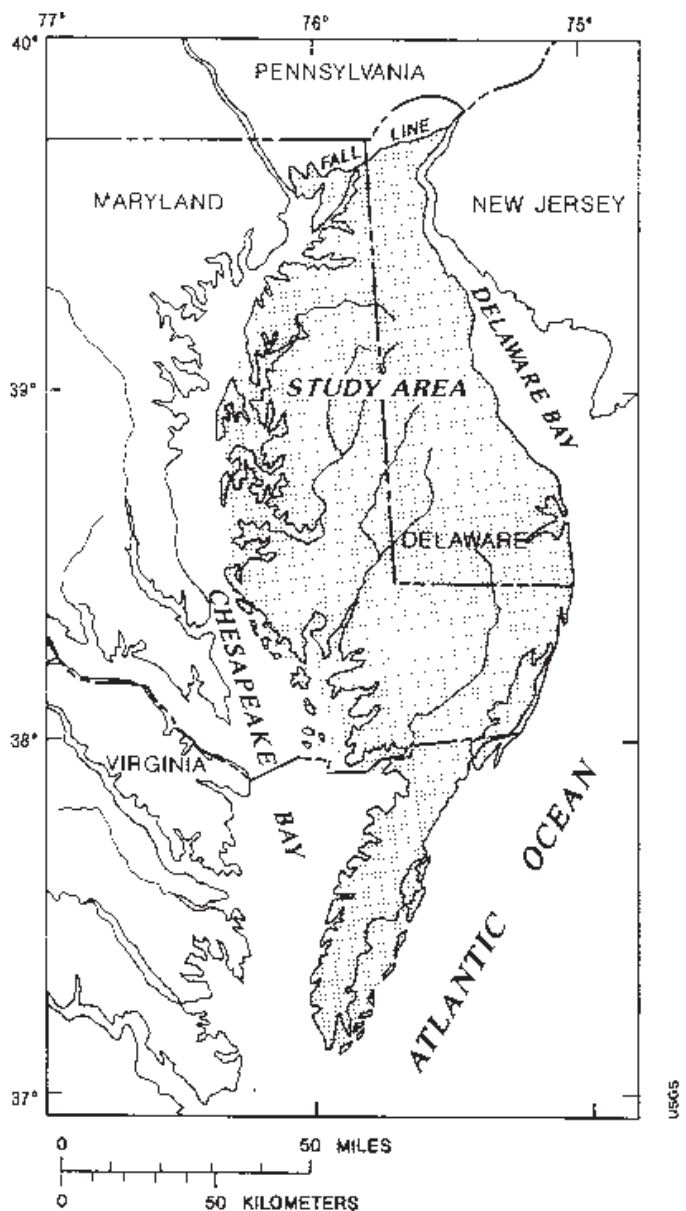
by Robert J. Shedlock (MS '75)

(Editor's note: Bob Shedlock is with the U.S. Geological Survey in Towson, Maryland. He is a member of a fifteen person interdisciplinary team conducting a water quality investigation of the Delmarva peninsula of Delaware, Maryland, and Virginia. The Delmarva study was one of seven pilot projects in the U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program. The program is designed to describe water-quality status and trends in a representative part of the nation's streams and aquifers. NAWQA is based on a multiscale, interdisciplinary design that is intended to provide a scientific understanding of the primary natural and human factors affecting water quality. This article originally appeared in the December 1993 GEOTIMES and has been adapted for Geoscience News with permission of the American Geological Institute.)

A regional water-quality assessment of the Delmarva Peninsula was undertaken by the U.S. Geological Survey from 1986 to 1992 and revealed that applications of commercial fertilizers, manure, and lime have changed the natural chemical composition of water in much of the surficial aquifer of the Delmarva Peninsula.

The Delmarva Peninsula is a gently rolling central upland surrounded by low plains that slope toward the Chesapeake Bay, the Delaware Bay, and the Atlantic Ocean. The peninsula is mainly a rural-residential area, with a population of about 600,000. The main crops are corn, soybeans, and small grains. The peninsula also has a large broiler chicken industry, and much of the manure is applied to the fields. Most of the peninsula is underlain by unconsolidated sands, silts, and clays of the Atlantic Coastal Plain. These sediments form a complex aquifer system consisting of a series of confined aquifers overlain by an extensive surficial aquifer. Nearly all the water supply for the peninsula comes from these aquifers. The peninsula is drained by a series of short tidal streams that become first- and second-order streams in the interior. Ground-water discharge is estimated to account for 60 to 80 percent of the total stream flow of the nontidal portions of streams.

The water quality assessment of the peninsula was based on existing data that were carefully screened for accuracy, and new data from several networks of wells and streams. The networks were designed to determine water-quality patterns at both regional and local scales and to assess if the water-quality patterns were related to regional differences in landscape features and hydrogeologic settings. The samples were analyzed for major ions, nutrients, and a large number of organic and inorganic trace constituents.



The team found that waters that recharged through agricultural soils have a characteristic chemical signature related to applications of lime and fertilizer. In most natural ground waters in the peninsula, the dominant ions are calcium, sodium, bicarbonate, and sulfate. In waters affected by agriculture, however, the dominant ions are calcium, magnesium, and nitrate. Waters recharged in residential areas that have septic systems also were found to have a distinct chemical signature characterized by sodium, chloride, and nitrate as the dominant ions.

It was also found that nitrate was the most pervasive water-quality constituent of concern on the peninsula. In the surficial aquifer, elevated concentrations of nitrate were detected in nearly all areas of the peninsula and at nearly all depths. In agricultural areas, nitrate exceeded the EPA maximum contaminant level for drinking water (10 milligrams per liter as nitrogen) in about 33 percent of the 185 analyses of water from the surficial aquifer. Furthermore, the distribution of nitrate in the surficial aquifer was strongly related to ground-water flow patterns and land use in recharge areas. The highest concentrations of nitrate were generally found in ground water recharged through well-drained soils in areas with intensive agricultural land use. High nitrate concentrations in deeper parts of the surficial aquifer generally resulted from recharge in agricultural areas upgradient in the ground-water flow system.

Herbicides were detected in the surficial aquifer in most areas. The spatial distribution of herbicides in ground water is mainly related to the distribution of agricultural land and herbicide usage patterns on the most common crops. The most commonly detected herbicides included atrazine, cyanazine, simazine, alachlor, metolachlor, and dicamba. The pattern of detections and the low concentrations suggest that the presence of herbicides in the shallow ground water results from water leaching through agricultural soils treated with these compounds.

Most of the water in the surficial aquifer was recharged in the last 40 to 50 years. These recharge dates were inferred from analyses of tritium and chlorofluorocarbons. The highest nitrate concentrations and most of the herbicide detections were in waters recharged after 1970, a time of substantial increase in the use of fertilizers and pesticides in the peninsula. Studies of the stable isotopes of nitrogen confirm that changes in nitrate concentration with age and depth in oxygenated parts of the surficial aquifer were caused by historical differences in agricultural practices rather than by nitrate reduction or hydrodynamic processes.

In an investigation of the effects of ground water on surface water quality, the team found that water quality in the nontidal sections of streams is related to factors affecting ground-water quality, such as hydrogeology, land use, and soil type. Nitrate concentrations in the base flow of streams were higher in well-drained landscapes than in poorly drained landscapes. In many areas, ground water that has the agricultural chemical signature and high nitrate-concentration flows under riparian zones in stream valleys and discharges directly to the stream through the stream bed. The scientists' work indicates that ground water is a probable long-term source of nitrate and trace concentrations of desethyl atrazine (a degradation product of atrazine) to streams.

These findings suggest that the shallow ground-water system contains a geochemical record of past land-use practices. Such findings have important implications for environmental policy-makers and managers, as well as for scientists. Ground water that has high nitrate concentrations and trace concentrations of pesticides will probably continue to discharge to streams that drain to tidal waters of the Chesapeake Bay. This discharge will likely continue for several decades, even if reduced application rates of agricultural chemicals are adopted, because of the residence time of water in the shallow ground-water system. Therefore, evaluation of the best management practices needs to be based on observations of both surface-water and ground-water quality. In the Delmarva Peninsula and other similar areas, water-quality improvements might be seen first in shallow ground water. The effects of new agricultural practices and environmental protection strategies may take years to be seen in other parts of the hydrologic system.

Faculty, Research Staff, and Student News

Jeff Alt reports that he and post-doc **Damon Teagle** traveled to Hawaii in January to attend the post-cruise science meeting from their ODP cruise of the previous year. Damon then continued on to New Zealand, his first visit home in several years, while Jeff later attended an EEC meeting in Spain about hydrothermal systems, with a field trip in the Iberian Pyrite Belt. Jeff and Damon are continuing their work on trace elements in altered seafloor rocks, and have sampled additional material for their study of metamorphism of arc crust.

Eric Essene and his students continue to be active in their research. Eric is currently preparing a paper on the significance of moissanite (SiC) in the mantle and another with Don Peacor on the pitfalls of clay thermometry. **Jodie Hayob** defended her dissertation in December on deep crustal xenoliths from Mexican volcanic rocks. Jodie is an assistant professor at Mary Washington College, Fredericksburg, Virginia. **Teri Boundy** married **Brad Singer** (Visiting Asst. Prof., '89-'90; now at Univ. Genève), and they just had a child, Zoe. Teri and Zoe will join Brad in Geneva this summer where Teri will complete the writing for her dissertation on Norwegian eclogites and amphibolites near Bergen, Norway. Teri has just had a paper accepted for publication in *Science* with Håkon Austrheim (Mineralogisk-Geologisk Museum, Oslo) on the formation and preservation of eclogite facies pseudotachylytes (melt rocks produced by deep earthquakes) in her field area. **Eleanor Dixon** is continuing her MS work on contact metamorphism in the southern Sierras in the vicinity of Tehachapi Pass. **Peter Tropper** is initiating petrological and chronological studies of eclogites and blueschists from the Sesia-Lanzo Zone of the western Alps for his PhD.

Several other graduate students who are working in part with Eric include **Jay Busch** (PhD on Grenville mylonites with Ben van der Pluijm), **Jim Cureton** (MS on Grenville mylonites with Ben), **Bernie Housen** (PhD on slates and mylonites with Ben) and **Ed Van Hees** (PhD on Archean gold deposits of Canada with Steve Kesler and Jim O'Neil). Bernie just defended his dissertation and will soon be a postdoctoral fellow continuing his work on young accretionary wedges. Eric is particularly looking forward to a field trip to the Four Corner kimberlites this summer with MS student **Liping Wang** and his advisor, Youxue Zhang. Liping's IR work on garnet xenocrysts from these kimberlites with Youxue suggests that their OH contents would be rapidly reset by diffusive processes during ascent from the mantle; they are giving a paper at the spring AGU meeting on this subject. **Klaus Mezger** (UM Postdoctoral Fellow, '89-'91) will visit the Department this summer and will continue field work in

the Grenville Orogen of Ontario. A new NSF Postdoctoral Fellow, **Jerry Magloughlin**, is now in residence at Michigan. Jerry is continuing his doctoral research (Univ. of Minnesota) on pseudotachylytes and their geochronology as well as the chronometry of Grenville amphibolites from the Adirondacks. A group of the above researchers will be attending the spring GAC-MAC conference at Toronto, where Jay, Jim and Ben will be presenting papers with coauthors Klaus, Eric and **Mike Cosca** (PhD, '89) in a special symposium on Grenville tectonics.

Bill Farrand has been heavily involved in service functions during this academic year. He is president-elect of the American Quaternary Association (AMQUA) which is planning its upcoming biennial meeting in Minneapolis in June. In that capacity he is charged, among other things, with soliciting nominations and putting together the ballot for AMQUA officers and councilors, a task involving much more time than anticipated. On the international Quaternary scene, Bill is Vice-chairman of the U.S. National Committee for the International Association for Quaternary Research (INQUA). The U.S. National Committee, appointed by the National Academy of Sciences, is charged with assuring American participation in the forthcoming quadrennial INQUA congress, to be held in Berlin in August 1995. This involves writing proposals for obtaining funds for travel grants for American Quaternary scientists.

On the home front, Bill's duties as Director of the Exhibit Museum are taking him into the arcane world of Museum administration. As a member of the Association of Science Museum Directors, he now needs to attend the annual (and large!) meeting of the American Association of Museums (Seattle, Apr.94), in addition to GSA, AMQUA, INQUA, etc.

One of **Dan Fisher**'s main objectives for this past winter has been development of techniques for producing a cast of the Brennan mastodon trackway, excavated recently near Saline, Michigan. Conventional casting procedures and materials are designed for subjects orders of magnitude smaller, so in order to produce a cast from the field mold that Dan and his team of volunteer assistants made, it has been necessary to improvise on a grand scale. Individual casts of footprints are now being produced routinely, methods for the large trackway are all in place, and production of the full cast is expected within about the next month. The bones of this animal may not rise again, but his footprints certainly will. The schedule for putting the cast of the trackway on display in the Exhibit Museum is not yet set, but it should be "coming soon." Progress has also been encouraging on a project involving 3-D digitization of the entire skeleton of the Burning Tree mastodon, one of the most complete and best preserved specimens available. This will be used for reconstructing details of butchering procedure, illustrating distributions of

marks on bones, and documenting the distributions of bones at newly excavated sites. Meanwhile, graduate student **David Fox** has been investigating growth lines in the tusks of present day elephants, to compare with the patterns seen in fossil material. It turns out to be more of a challenge to obtain tusk samples from extant elephants than from the fossils. On other subjects, **Brian Bodenbender** is deep into the writing phase of his dissertation, wrestling with morphologic, crystallographic, and stratigraphic data on blastoid echinoderms. The dust hasn't cleared yet, but we're sure Brian will come out on top.

Phil Gingerich spent October and November in the field in Egypt with Geology graduate student **Will Clyde** and Museum of Paleontology vertebrate preparator **Bill Sanders** collecting Eocene marine fossil whales and sirenians. The desert west of Fayum Oasis has proven to yield numerous exceptionally complete skeletons that are well preserved and contribute greatly to our understanding of the evolution of Eocene marine mammals.

Graduate student **Xiaoyuan Zhou** is finishing his doctoral dissertation on Mesonychidae, the group of land mammals thought to have given rise to whales. A paper on a new middle Eocene archaeocete from Pakistan has just been published in *Nature*. Graduate student Mark Uhen is beginning dissertation research on the most interesting Egyptian fossil whale, *Prozeuglodon*, which is now known from virtually complete skeletons, enabling a much better understanding of the functional morphology of this important stage of evolution. Mark and Phil received a University Research Partnership award to support his research, and Mark received a Smithsonian Predoctoral fellowship which will enable him to work intensively in Washington through the summer.

Chris Hall reports that the used argon mass spectrometer acquired from the University of Cambridge, the VG1200S is now operational. This machine has excellent sensitivity and low blank and will be perfect for use with our laser extraction line. There was a little more excitement getting the machine on-line than expected. It had leaks and a truly idiosyncratic English control microcomputer. With a few new parts, some reconditioning, a venerable IBM PC, some new software and a little tender loving care, the VG1200S is probably now working better than it ever has!

Chris has been studying some high-Ti lunar basalts sampled at the Apollo 11 site, in collaboration with Greg Snyder of the Univ. of Tennessee, Knoxville. The $^{40}\text{Ar}/^{39}\text{Ar}$ results are encouraging, and tend to support the model (based on earlier Sm-Nd analyses) that these basalts formed about 3.8 billion years ago. Also, Chris' study of tephra units from an ODP core from the Indian Ocean has yielded a new high precision age estimate for the Nunivak geomagnetic event. The new $^{40}\text{Ar}/^{39}\text{Ar}$ age is significantly older than the "standard" time scale value, but it agrees exactly with astronomi-

cally-derived time scale predictions based on the Milankovitch hypothesis. The automation system is now fully installed, and control software (now about 20 pages of Pascal source code) is nearly complete. A major milestone has been passed in that the first fully automated gas analysis has been obtained.

A major collaboration with Hailiang Dong, Alex Halliday and Don Peacor has had some major successes. Preliminary $^{40}\text{Ar}/^{39}\text{Ar}$ work on clays from Welsh basin shales found ages in agreement with both stratigraphy and with earlier Sm-Nd work by **Matthias Ohr**. This was a bit surprising since the clays are exceedingly fine-grained and major loss of ^{39}Ar from recoil was anticipated. In contrast we did find that illite/smectites from Welsh basin bentonites appear to lose a significant percentage of their ^{39}Ar . Subsequent TEM studies are shedding light on possible controls on recoil loss mechanisms. We also have begun (almost as this is written) a series of technically challenging experiments in which we are directly measuring the recoiled Ar isotopes. Preliminary work on a sample which was suspected to suffer little recoil loss has indeed only released a small quantity of ^{39}Ar . The goal is to understand and control ^{39}Ar recoil, so that $^{40}\text{Ar}/^{39}\text{Ar}$ dating, with its exceptional precision, can be applied to studies of diagenesis and direct dating of sedimentary rocks.

The big event during the last term for **Steve Kesler** was publication in January of his book "Mineral Resources, Economics and the Environment" (Macmillan). Since completing the book, Steve has gotten back to work on a lead isotope study of Appalachian Mississippi Valley-type (MVT) deposits with George Cumming at the University of Alberta. Lead in these deposits turns out to come from two main sources, Grenville-age basement rocks and Paleozoic-age igneous rocks, and it defines large several regional brine-flow provinces. The next stage of the work will be a search for the actual basins from which flow provinces originated. During January, Steve was external reader for Rod Randell's dissertation (Univ. of Toronto) on the Polaris MVT deposit in the Arctic and lectured at the Universities of Toronto and Windsor. In February, **Joe Graney**, **Ed Van Hees** and Steve went to the USGS McKelvey Symposium in Tucson, where they visited **Joaquin Ruiz** (PhD, '83) and **John Chesley** (PhD, '93) and saw the outstanding lab that Joaquin has set up at the Univ. of Arizona.

Becky Lange's research group has been growing rapidly with two graduate students this year, **Robert Cooper** and **Fred Ochs**, to join **Jean Tangeman** and **Sharon Feldstein** in the field and laboratory. **Robert Cooper** is beginning an experimental study of ferric-ferrous equilibria between clinopyroxene and basaltic liquids. Fred Ochs has begun the first measurements of the density and compressibility of hydrous silicate liquids. Jean Tangeman is immersed in both

heat capacity and viscosity measurements (≤ 2000 °C) on silicate liquids undergoing composition-induced coordination change of Fe^{3+} and Al^{3+} . In Jean's spare time, she continues to work on her basaltic rocks from the Big Pine Volcanic Field in eastern California. Sharon Feldstein is also involved in a field study of ultra-potassic basaltic rocks that erupted along the crest of the Sierra Nevada in eastern California ~3 Ma. In addition, she is busy measuring the bulk compositions, ferric-ferrous ratios (by wet chemistry), water contents (by manometry), and D/H isotopic ratios of biotite separates from a variety of igneous rocks; her goal is to correlate the oxidation state and water content of her biotites to different tectonic settings (subduction zones, continental rifts, hot spots, etc.). While the graduate students slave away, Becky Lange is pursuing field work of her own in northeastern California and is developing a new technique that will provide the first direct measurements of the thermal expansion of silicate liquids.

Phil Meyers is exploring the organic geochemical records of some interesting parts of earth history. As an outgrowth of his long-lived study of chalk-marl cycles in marine sediments, he has been looking into evidence of changes in marine productivity around Antarctica as preserved in sediments deposited on the Maud Rise (Weddell Sea) during the Eocene and Oligocene. This is the time during which the Antarctic icecap started to form and to expand. He is collaborating with marine sedimentologists in Germany on this project and is consequently reviving his annual visits to Saarbrücken and other German universities. As a spin-off of his studies of changes in organic matter accumulation around the time of the K/T boundary extinctions, Phil has started to work with **Robyn Burnham** of the Museum of Paleontology to compare the "paleobiogeochemicobotany" of fossil leaves present in Danian sediments at Raton Pass, Colorado. The idea that is being investigated is to see if there are geochemical signatures representative of the different plants that were buried at this location shortly after the K/T boundary.

All of the graduate students in the Organic Geochemistry Group are doing interesting things, too. **Beth Kowalski** is finishing her MS project on comparison of the organic matter present in chalk-marl cycles on the Chatham Rise of New Zealand and on the Rockall Bank off Ireland. **Gab Tenzer** is putting together the final touches to a study of the redistribution, sorting, and focusing of surficial sediments in Pyramid Lake, Nevada, that will be part of her MS degree. **Jim Silliman** and **Eileen Ho** are actively in the planning stages of their PhD research projects, both involving environmental organic geochemical records in the Great Lakes.

Sam Mukasa just stepped down from the Polar Programs panel at the National Science Foundation (NSF) and is happy not to have to read grant proposals by the pound twice a year. He has, however, agreed to serve on the Advisory Board for

the Office of Polar Programs at NSF for three years. In October, 1993, Sam and graduate student **John Encarnación** (PhD, '94) spent some time in northern California sampling the Trinity Peridotite in the Klamath Mountains for isotopic and trace element studies. This peridotite provides one of the best and largest windows into the suboceanic upper mantle, and is therefore well suited for studies addressing the length scales of mantle chemical heterogeneities. In November and December of 1993, Sam and graduate students **David Minor** (MS, '95) and **Pinbo Zhou** (MS, '94; PhD, '98) traveled to Antarctica to study the Dufek layered mafic intrusion, a well kept secret second in size only to the Bushveld Complex in South Africa. Dave and Pinbo are to study different sections of the intrusion, employing trace element and radiogenic isotope analyses of mineral separates to elucidate the melting and fractional crystallization processes in large, water-poor mafic magma chambers. While Dave and Pinbo were freezing in an ice cave at the US Antarctic Program Survival School, Sam went on a reconnaissance flight of the field area, and for what it is worth, became the first Ugandan-American to reach the South Pole. (see photograph on page 4) Field work at the Dufek Massif was a tremendous success, and it yielded so many samples that the ski-equipped LC-130 aircraft that came to pick them up at the end of the season failed to take off on the first two attempts.

Bob Owen and his graduate students have spent most of the winter semester writing up the results of various research projects. **Gerry Dickens** has just completed a marathon effort to submit three papers in time for the deadline for the ODP Leg 145 (North Pacific) *Scientific Results* volume. Among these are papers reporting the discovery and possible formation mechanisms for native copper and associated minerals found in sediments from the Detroit Seamount, and a paper discussing the massive deposition of hydrothermal materials in association with the onset of rifting of the Chinook Trough. Gerry will spend May and June as a visiting scientist at the Department of Energy Laboratory in Berkeley, California. **Sean Paulsen** has completed the first draft of his M.S. thesis which describes a quantitative model for identifying sediment dispersal patterns in Northern Cardigan Bay in the Irish Sea. Sean plans to continue this line of research in studies leading to a PhD. **Peter Knoop** is currently working on a paper describing how different elemental accretionary processes influence the bulk composition of ferromanganese nodules recovered in the region of the Clarion and Clipperton Fracture Zones in the Central Pacific. Peter intends to conduct detailed "time slice" analyses of individual nodules to determine the relationship between compositional variations and paleoceanographic events. **Egon Weber** has recently joined Bob's group and has begun follow-up studies on work reported by **Annette Olivarez** (PhD, '89). Egon will be using a combination of geochemical and geostatistical analyses to isolate and identify the relative

abundance of the eolian component of modern sediments recovered from throughout the entire North Pacific Ocean.

Clay minerals and TEM have given rise to some exciting research results in **Don Peacor**'s group this last year. **Hailiang Dong**, while working with Chris Hall and Alex Halliday has just engineered a major breakthrough in Ar/Ar age determinations. **Wei-Teh Jiang** got his PhD and is now at ASU on a post-doc, having successfully answered major questions about illite crystallinity, while **Jin-Wook Kim** has tested the "magic bullet" for TEM work on smectite, opening up a whole new area of work. **Dick Merriman**, **Brin Roberts**, and **Bob Freed** (PhD '66) all made visits, in part to use the EMAL, and work also continues with **Yen Hong Shau**, **Fernando Nieto**, and **Harue Masuda**. **Geijing Li** (working on the New Zealand samples collected with Doug Coombs last year) and **Weixin Xu** (continuing to explain the mysteries of paleomag via TEM, with Rob Van der Voo) are expecting an addition to the family next July. **Nei Che Ho** and **Vicki Hover** are about to collect samples in the wilds of the Mississippi River delta, Vicki to study clay/water interactions with Lynn Walter, and Nei Che to expand studies of preferred orientation of clays using his dandy, newly-designed and constructed pole figure device. The best news of all for Don Peacor is that he and **Steve Bohlen** (PhD '79) gratefully handed the reins of the American Mineralogist to new editors, who along with Vicki Lawrence keep that machine running smoothly.

Dave Rea has spent much of the winter wondering whether it would ever end and if we were seeing a volcanically-induced cooling resulting from the (century's largest) Mt. Pinatubo explosive volcanic eruption of 1991. New graduate student **Libby Prueher** arrived in January from the USGS California just in time to join nature's refresher course in continental climate regimes. Graduate student **Dave Dobson** finished his MS work with **Ted Moore** on the high-resolution seismic stratigraphy of Lake Huron and Georgian Bay and sailed off on the Ocean Drilling Program's ship to spend two months in the equatorial Atlantic. His project will involve the geologic and geochemical history of the Amazon drainage basin based on the Amazonian sediments accumulated on the sea floor. **Hilde Snoeckx** continues her work on the Quaternary record of oceanographic processes in the eastern equatorial Pacific, but took a few months off to complete her studies of North Pacific eolian deposition that arose from her participation in the North Pacific Ocean Drilling Program cruise in 1992.

This past year continues to be a busy time for **Larry Ruff** and **Kenji Satake** around the seismology laboratory. They became adjusted to their new accommodations just in time for the many significant earthquakes of 1993. Graduate student **Yuichiro Tanioka** is finishing his seismic wave and tsunami

work on several of the large earthquakes that occurred in 1993; notably the Hokkaido and Guam earthquakes. Graduate student **Jean Johnson** is working on a curious earthquake doublet that occurred in Kamchatka in 1993 — one event caused a tsunami, while the other did not. In addition, Jean and Prof. Kenji Satake continue their work to find the total fault slip of the 1964 Great Alaskan earthquake — it is huge! Kenji continues to be deeply involved in "predicting" the tsunami that will occur after the next great Cascadia earthquake. On the theme of earthquake doublets, graduate student **Nazli Nomanbhoy** is finishing her work on this surprisingly common behavior of subduction zone earthquakes. Nazli has developed a simple model that can produce doublets in great quantities! In the wake of the widespread remote triggering observed after the 1992 Landers, CA, earthquake, researcher **Leonid Zimakov** has found further evidence to support remote triggering in the western United States. Leonid analyzed the global seismicity catalog from 1964 up to 1990, and discovered that 18 "extra" earthquakes occurred 10 to 20 days after large events elsewhere in the western United States — Leonid is looking for other ways to ensure the significance of these results — any good ideas would be appreciated! On related matters, Leonid and Larry Ruff have been working on theoretical models to explain the remote triggering observations — good ideas are also appreciated here!

In a previous newsletter, we noted that the venerable Anna network no longer existed. But now, we are trying to implement a newer and better network based on "independent yet cooperative" digital seismographic stations. We hope to set up several stations in Michigan and the greater Great Lakes region to complement and work with our Ann Arbor station; we'll keep you posted on developments in this arena.

To update our geodynamics fans, the "big" news item is the Prof. Mike Gurnis decided that mantle convection looks better in Pasadena. We are sad to see Mike go, but we wish him the best in his new position at Caltech. Also, graduate student **Mark Russel** has finished his degree and is now working in the "oil patch" division of Union Pacific (after a nice vacation in New Zealand). Our remaining resident geodynamicist, graduate student **Shijie Zhong**, is working hard to finish his thesis for this spring; his work with Mike helps to explain why trenches are deep! Positive news on the geodynamics front is that we are currently searching for a geodynamicist replacement; we now have approval for a two or three year temporary position, and we hope to obtain approval for a permanent position.

As always, our friends are welcome to drop by the seismo lab — we were quite happy to see **Jim Gaherty** stroll in just recently!

Ben van der Pluijm and the Structure Lab are part of the first wave in the Department's renovation plans and related moves.

When you read this, Ben's office and the enlarged Structure Lab will have moved to the North side of the building (facing the Dental School). Together with **Rob Van der Voo**, who will also move there, this will be part of the Paleomagnetism, Structure and Tectonics (PaSTeL) unit. You'll read what it was really like to move in the next newsletter. **Bernie Housen** (PhD, '94) successfully defended his dissertation project on magnetic fabrics in deformed rocks, but decided to stay for another year as a post-doctoral fellow to work on research related to the Ocean Drilling Program. **Jay Busch** (PhD) and **Jim Cureton** (MS) continue to work on deep-orogenic extension in the Grenville, which is taking them from the field to the microprobe to the radiogenic isotope lab, and back to the field. **Steve Potts** (PhD) is trying some Nd isotope fingerprinting of clastic sediments (with **Alex Halliday** and **Liz Meyers** (MS) will analyze Silurian rocks from Maine as part of Rob and Ben's Appalachian paleogeography project. **Nei-Che Ho** has finalized a study of perhaps the best examined cleavage outcrop in the world (at Lehigh Gap, PA) using our new high-resolution X-ray texture goniometer and electron microbeam techniques (a joint project with **Don Peacor**), which elegantly shows the competition between mechanical and chemical processes. Finally, Ben tries to interfere with the work of two other post-doctoral fellows, **Jerry Magloughlin** and **John Stamatakos**, but something about their projects next time. Returning from his sabbatical, Ben is again enjoying the classroom with courses on "How the Earth works" and, of course, "Earth structure." On the home front, the kids are growing like there is no tomorrow. It is safe to say that they are hardly vertically challenged and that they keep Lies and Ben nicely occupied in their "spare" hours. But relief is here: Spring!

The paleomagnetic research laboratory of **Rob Van der Voo** has been rejuvenated with completely new equipment, now all installed and functioning. The new cryogenic magnetometer is working extremely well and uses little liquid helium. The new thermal demagnetizer, magnetic anisotropy bridge and a new alternating field demagnetizer complete the picture. Postdoctoral fellow **John Stamatakos** has been funded to work on curved mountain belts (oroclines), with those in Pennsylvania, Wyoming, and northern Spain the principal targets. Remagnetizations induced during the deformation are also of interest. Visiting scientist **Trond Torsvik** from the Geological Survey of Norway is continuing his work on the magnetostratigraphy and paleopole positions of Siberia and northern Norway. **Weixin Xu** is completing this year his study to explore the effects of chemical change due to hydrothermal alteration on magnetic oxides in ocean-floor basalts and the Precambrian Stillwater Complex. This project of Rob and **Don Peacor** has been funded recently by NSF. Electron microscopy techniques are used to examine the carriers of magnetization. The work of postdoctoral fellow **Joe Meert** on the Precambrian of East Africa will be wrapped

up shortly before he starts work this Fall as assistant Professor at Indiana State University. **Steve Potts** and **Sean Todaro** are about to finish their theses on Ordovician and Silurian rocks from Newfoundland and Maine and **Liz Meyers** is sampling Silurian rocks this summer in Quebec. We will probably see two new graduate students join the group this fall, and also look forward to welcoming Visiting Scientist **Josep Pares** from Barcelona, who will spend a sabbatical in Ann Arbor.

Youxue Zhang is busy teaching and carrying out two projects funded by NSF. One is an experimental study of volcanic eruptions in which gas-driven violent eruptions are simulated in miniature in the lab. The experimental results are recorded using high-speed movie films and examined frame by frame for the dynamics of the process. The issues to be addressed are the conditions under which an eruption occurs and the dynamics and energetics of the eruption. The other project, newly funded, is a study of the equilibrium and kinetics of the water speciation reaction in silicate melts. Experiments are carried out at both 1 atm and high pressure in the new experimental petrology lab. To expand research into real rocks and field geology and by cooperating with **Eric Essene**, Youxue is venturing into projects on kimberlites. The new adventure involves also **Liping Wang** and a new student, **Donggao Zhao**, who has been accepted by Eric and Youxue.

Students working with Youxue Zhang are making progress in their research. Liping Wang is continuing his experimental study of dehydration of mantle garnet crystals (though nominally anhydrous, these crystals contain 10 to 100 ppm water). The dehydration of garnet crystals is relatively rapid. His data also indicate that the process is more complicated than expected and the dehydration rate depends on the water content. He recently expanded his project to include a field study of the Four Corners kimberlites and an application of thermobarometry and speedometry to these rocks. **Robert Cooper** (working with both **Becky Lange** and Youxue) is working on the partition of ferric and ferrous iron between clinopyroxene and silicate melt and dabbling in diffusion projects.

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.

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In Memoriam

N. James Clinton (BS '51) of Carrollton, Texas, passed away in 1992. He was still actively and enthusiastically working at Mobil in the Geology and Petrophysics division as Imagery Applications Team Leader.

William C. Fackler ('42) passed away September 21, 1993, in Friday Harbor, Washington.

Annabel Olson (a friend of the department) of Bethesda, Maryland, passed away.

John W. Vanderwilt (BA '22, MS '23) passed away in Upland, California, in December 1993.



William S. Carlson

**BS '30, MS '32,
PhD '38**

Died May 8, in Belair Florida at age 88. He was born in Ironwood Michigan in 1905. Served with the U.S. Air Force during the Second World War, helping to establish air bases and an air route to Britain over Canada, Greenland, and Iceland. He served as president of four State Universities during his career; University of Delaware 1946 to 1950, University of Vermont 1950 to 1952, University of New York 1952 to 1958, and University of Toledo 1958-1972.

Degrees Granted

BS

Michael Barrie
Charles Breitreose
Ronald Dixon
George Frederickson
John Hansen
John Hickman
Stanley Sharik

Christopher Smid
Kenneth Thiemann
Zachary Tucker
Dino Van Denheede
Aimee Vitateau
Mun Wong

MS

William Clyde "Rates of evolution in the dentition of early Eocene Cantius: Size and shape"

David Dobson "The Sedimentation History of Lake Huron and Georgian Bay: Results from analysis of seismic reflection profiles"

Henry Fricke "Infiltration of Meteoric Water into rocks below the brittle/plastic transition: Evidence from the Ruby-East Humboldt Range, Northeastern Nevada"

Joe Hughes "Timing and progression of diagenetic alteration in the Oligocene Suwannee Limestone, west-central Florida: Implications for rates of calcitic carbonate diagenesis"

Jin-Wook Kim "A technique for maintaining texture and permanent expansion of smectite interlayers for TEM observation"

Peter Knoop "Computer software for identifying compositional subpopulations in marine sediment geochemical data using threshold value analysis"

Nazli Nomanbhoy "A Simple Discrete Element System to Model Multiplet Earthquakes and Numerical Computations of the 1883 Eruption of Krakatau"

Ph.D.

David Dettman "Stable isotope studies of fresh-water bivalves (unionidae) and ostracodes (Podocopida): Implications for Late Cretaceous/Paleogene and Early Holocene paleoclimatology and paleo-hydrology of North America"

Carl Drummond "Stable Isotopic and Stratigraphic Proxies of Local, Regional, and Global Climate"

Jodie Hayob "Xenoliths from Central Mexico: Experimental, Mineralogical and Petrological Evidence for High Temperature Metamorphism of the Lower Crust"

Bernard Housen "Quantification of Deformation Fabrics in Various Rocks Using Magnetic Anisotropy"

Der-Chuen Lee "A Chemical, Isotopic and Geochronological Study of the Cameroon Line, West Africa"

Joseph Meert "Precambrian Tectonics: Some Constraints from Paleomagnetic Studies in North America and East Africa"

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Surname First Middle Area Number

Residence Address _____
Street Address City State Zip

Business Address _____ Business Telephone _____
Position Company Area Number

Street Address City State Zip

Degree _____ College or University _____ Year _____

Degree _____ College or University _____ Year _____

Degree _____ College or University _____ Year _____

Spouse _____
Name Year of Wedding

Children _____
Name Birth Date Name Birth Date

Children _____
Name Birth Date Name Birth Date

Children _____
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 _____ Telephone _____
Relationship Area Number

Street Address City State Zip

Please send us any news of your "doings" to be included in the next newsletters; simply write it on the reverse side of this sheet.

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Alumni Information File Update

We are in the process of undertaking a comprehensive update of our Alumni Information File. With each Newsletter there is attached an information update form, and our mobile alumni have been very good about sending changes of address as they have moved about. However, other information, e.g., about current employment and family, have slowly slipped in currency and accuracy. Thus we are asking EVERYONE, whether or not there are any recent changes to report, to complete the ENTIRE information form appearing as the last page of the Newsletter and return it to the Department. Thanks very much for your assistance in keeping our files up-to-date.

The List of The Lost

From time to time we publish the names of alumni and friends of the department with whom we have lost contact or no longer have current addresses. We would be grateful to receive information about these folks' whereabouts so that we can once again include them among the readers of *Geoscience News*. ND=no degree

Amanda Joyce Alexander MS-82	Jeannette Marie Fini BS-73	Donald Campbell Lamb ND-58	Kenneth Joseph Rogers MS-57
Nasser Saad Al-Muneef MS-74	Kim Finkbeiner BS-89	Colleen Loretta Lanford BS-80	Paul J. Roper BS-62
Enrique Manuel Araujo ND-56	Robert Smythe Fleming BS-52	Jon Robert Lauer AB-78	Melvin Rotblatt AB-45
Gary Mervyn Archibold MS-60	John Doster Focht MS-56	Malcolm McLean Lawson BS-60	Chester Rutkowski BS-51
Robert Holt Ardrey MS-78	L. Fong MS-80	Dallas Marion Lemmon BS-57	Mark A. Sabol ND-70
Joanne Mary Bahura BS-83	Richard Stanley Gabrielson ND-72	Lit-Kwan Leung	Peter Schappach BS-87
Colin Woods Baker MS-82	Christodoulos Alexander Galas BS-56, MS-58	Marcel Romuald Lizotte BS-59, MS-62	Barbara Jean Schlecte BS-84
Richard Calvin Baker PhD-62	Scott Verne Galbraith BS-77	Cornelius James Loeser MS-47	Arijeet Sengupta MS-84
Muhammed Abu Bakr MS-62	Luis Garza-Rios BS-89	John Long BS-51	Willis H. Shafer BA-52, BS-60
Alferid Balian ND-71	Armando Alfonzo Giardini BS-51, MS-53, PhD-56	Charles K. Lucas BS-50	Helen Adair Shaver BS-44
Irene Diane Banas BS-78	Lia Ann Fong Gough MS-84	Curtis P. Mabie MS-58	Frank D. Sheldon ND-65
Orhan Baykal ND-46	David Lawrence Graf BS-57	Jose Alberto MacCourtney MA-44	Thomas Skimming BS-58
Michael Henry Berry BS-72	Richard John Greenwood MS-69	Steven Dean Macheimer BS-80	Alois M. Skutnik BS-50
Daniel John Bickel BS-68	Mary Oswald Griffiths BS-41	Carlton Wesley Malstrom BS-51	Amanda Lee Smith BS-82
James Boudouris BS-52, MS-55	Wayne Milton Haglund ND-68	Peter Mellen Mann BS-51, JD-57	Edward William Smith BS-42
Darwin Spencer Braden BS-58	Richard Clay Harbke MS-60, MBA-62	Jacob Margulies BS-89	George Ephriam Sokolsky MS-60
Eleanor Johnson Buchanan BS-47	Donald Paul Harndon BS-53	Ernest Millard Marshall MS-50, PhD-77	Marvin Andrew Speece MS-84
Richard L. Buck BS-55	Donald Martin Hausen ND-55	Leon Charles McCaughan BS-69, MS-71	Christine Marti Sperber BS-84
Chris Buczynski BS-81	Edgar Douglas Haymond BS-56	John Elliott McEneaney BS-75	David John Stawski BS-61
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Carol Irene Dell PhD-71	Jubal Lee Kohlmeier BS-77	Talal M. Rabiah PhD-89	Julia Ann Broadfoot Wells BS-67
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David W. Elias BS-50	Richard H. Kosoneni BS-61	Pamela Patrick Redden ND-72	James E. White ND-51
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George Lawrence Evans BS-59	Ragvir Gopal Kumble MS-62	James Albert Rodwell BS-62	Jean Davies Wright MS-55
Lee Hendrick Farbsten BS-42	Douglas Haig Kyle MS-58	Burton Clarke Rogers AB-51	Stephen Jonathan Zier BS-59
Edward Farmer BS-89	Felix Anthony Lally ND-56		

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