

GEOSCIENCE NEWS

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



December 1992



In This Issue:

Greetings from the Chair	2	An Indonesian Experience by D.F. Todd	9
Alex Halliday Receives First Geoalumni Award	3	Honors	13
An Ancient "Cold Snap" Resolved	5	Faculty, Research Staff, and Student News	13
New Research Scientist	6	Memorial to Charles D. Campbell	19
University Embarks on Historic Campaign	6	In Memoriam	20
Alumni News	6	Degrees Granted	20

Greetings from the Chair

It has been as quiet in the Department as in Lake Wobegon this summer and even this fall. Conditions are stable and people are getting on with their work. With the appointment of Tom Merline to replace Marlene Allen (who retired in June after nearly fifteen years in the Department), we have begun a detailed examination of the budgets of Geological Sciences, which show ever-increasing complexity. I am happy to report that the finances of the Department are in good shape, although there is not enough (never enough) money for graduate student support and for equipment. The total annual cash flow of our Department is some \$5.2 million, of which about 45% comes from external grants. The annual cost to support our 71 graduate students now surpasses \$1.4 million. While much of this cost is borne by external grants and university teaching assistantships, a sizeable component (about \$100,000) is funded by annual alumni and company gifts as well as endowed fellowships. Overall, some 120 people are employed in the Department; those of you who are used to intermediate businesses of that size will recognize that the total departmental budget is comparable in magnitude to that of a company with 120 employees. Our 25 faculty are the middle managers in this educational and scholarly enterprise.

In contrast to the naive notions that we all had as students aspiring to faculty careers, we have found ourselves as professors to be involved in typical management duties for about 50% of our time: these duties involve proposal and report (and newsletter!) writing, course development and teaching reviews, personnel supervision and evaluation, budget projections and reconciliations, and—of course—the interminable and abundant committee meetings. The more visible teaching and hands-on research tasks occupy most of us for no more than half our time. No-one is complaining directly about this, mind you. It is, however, a surprise to people outside the universities: my wife Tanja, a high school teacher, stands before the classroom 25 hours per week and scoffs mildly at the six weekly classroom hours of the typical professor at a major research university.

The Geological Sciences Alumni Advisory Board (see cover picture) that met this October in Ann Arbor was treated this year to an expanded analysis of the issues mentioned above. They also considered detailed budget components and funding needs; elsewhere in this newsletter the Capital Campaign of the University and its departmental component will be briefly described. The Geoalumni Board established a faculty award this year and honored Prof. Alex Halliday as its first recipient.

The award comes with a \$1,000 after-tax check. A feature article in this issue highlights Alex's accomplishments and shows that this award is well-deserved. The Board hopes to continue the tradition in future years, as conditions, nominations and funds permit.

Renovations on the fourth and fifth floor in the geophysics area and for a new mineral separation facility, funded jointly by the University and the National Science Foundation, have finally been completed. If you are in the area, by all means stop by and engage one of us in a guided tour.

Sincerely,



Rob Van der Voo
Chairman

On the Cover:

Members of the Alumni Board and their spouses enjoy a pre-game brunch in the Ann Arbor sun (October 3, 1992). Clockwise from upper left are David Nussmann, Tanja Van der Voo and Donna Marie Joity, Drew Isaacs, Laurie and Fred Metzger, Helen Foster, Rob Van der Voo and George Davis, and Ed Poindexter. Also present but not captured by the camera were Chair John Joity and Jim Masterson.

Alex Halliday Receives First Geoalumni Award

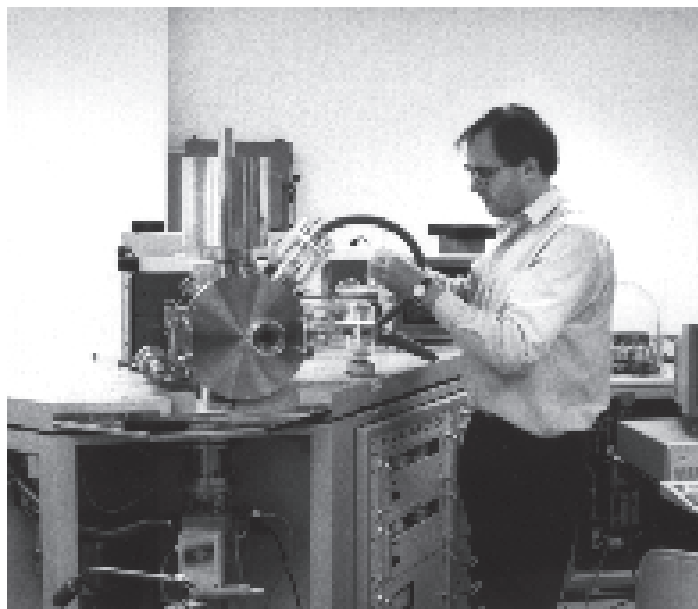
This Fall, Alex Halliday became the first recipient of the University of Michigan's Geoalumni Award for Excellence in Teaching and Research. He was presented with the award by Board chairman John Joity at the annual meeting of the Alumni Board on October 2nd in recognition of his impressive experience and reputation in both teaching and research. Since coming to Michigan he has carried a full teaching load and developed one new course each year, on top of building the new (actually more than 5 years old) Radiogenic Isotope Geochemistry Laboratory and its associated lively research programs. In his teaching he has demonstrated a gift for making geology and geochemistry exciting to students from non-concentrators to graduates. In his instruction of undergraduates he has focused on the subject of time and the larger scale aspects of how planet Earth works, trying to explain radioactive decay equations and isochrons in ways that the non-specialist can appreciate. His graduate lectures and seminars have been aimed at bringing the latest developments in isotope geochemistry to the forefront, in addition to ensuring that every person is familiar with the principles of isotope geochemistry. He has consistently received very high student ratings for the quality of his teaching.

Alex's earliest major research endeavor in the field of isotope geochemistry was his Ph.D., undertaken in the Department of Geophysics at the University of Newcastle-upon-Tyne in England, where he won the Microwave Instruments Research Prize for his research on the timing of regional hydrothermal events in the continental crust and their relationships with global tectonic changes. He published a number of papers on the applications of potassium - argon (K-Ar) and ^{40}Ar - ^{39}Ar dating to ancient hydrothermal processes. These included the first papers showing that the Hercynian mineralization of western Europe was affected by subsequent hydrothermal activity related to the break up of Pangaea.

Following his Ph.D. he broadened his research interests further, and took a N.E.R.C. postdoctoral fellowship at the Scottish Universities Research and Reactor Centre (S.U.R.R.C.), permitting him to learn rubidium-strontium (Rb-Sr) and uranium-lead (U-Pb) techniques. Since most isotope geochemistry at that time seemed focused on the Moon and meteorites, Earth's mantle, and the early Earth, Alex decided to work in an area that at that point had been largely neglected with state-of-the-art high precision Sr isotopic measurements, namely the origins of granites. He published several papers on the origins of granite magmas, including the first isotopic study of the causes of compositional zoning in plutons. After five years as a postdoctoral fellow he

was given a tenured lectureship with Glasgow University and became leader of the solid source research group at S.U.R.R.C. He further expanded his research by using samarium-neodymium (Sm-Nd) methods, collaborating with others engaged in (stable) oxygen isotope geochemistry. He again shifted the focus of his research to young silicic volcanic systems, especially those of the Long Valley caldera, Mt. St. Helens, La Primavera (Mexico) and Yellowstone, with the aim of understanding how such magmas mix and differentiate. He also developed new research programs on the Scottish lithosphere, studying mafic enclaves with graduate student Peter Holden, as well as mantle and lower crust xenoliths independently excavated by alkalic basaltic magmas. These research enterprises were very successful, allowing an integrated approach to understanding the continental lithosphere. At the same time he rekindled his interests in hydrothermal processes. He developed Sm-Nd dating of fluorite and, with a student, Hanni Mills, produced the first high resolution Pb isotopic study of a giant sedimentary exhalative sulfide deposit for which a chronology of hydrothermal deposition could be readily established, in order to test models regarding the depth of fluid circulation in the continental crust.

In 1986 Alex left S.U.R.R.C. and came to Ann Arbor with his wife Christine Young, to take the position of Associate Professor at the University of Michigan. He built a new radiogenic isotope geochemistry laboratory, better equipped to tackle innovative problems requiring particularly small



samples and hence low blanks. He began studying magma production rates and residence times using Rb-Sr and ^{40}Ar - ^{39}Ar dating of high Rb/Sr rhyolites to determine the time spans of differentiation and magma residence in Long Valley, Coso and a variety of systems in Utah. This has been a major research focus for two postdoctoral scholars Gareth Davies and John Christensen and a research scientist, Chris Hall. With Zach Sharp, a former Ph.D. student of Eric Essene, he developed micro sampling techniques, closely following the methods that K.C. Lohmann had developed for carbonates. Former postdoc John Davidson and graduate student Sharon Feldstein both used this facility for dissecting putative magma mixing assemblages. Alex also built upon an earlier collaboration with Godfrey Fitton at the University of Edinburgh, studying the Cameroon line volcanic chain from the perspective of mantle dynamics. This research has developed further with studies of ocean islands in the entire central Atlantic region and now involves several students and postdoctoral fellows, notably Der-Chuen Lee, Gareth Davies, Cassi Paslick and Simone Tommasini. The work has assumed greater prominence with the important discovery of large fractionations in U/Pb and Ce/Pb in the upper mantle, acquired during the lifetime of the Atlantic Ocean and detectable using combined Pb isotopic and isotope dilution U and Pb measurements on young basaltic lavas. Alex thinks these discoveries have important implications for our understanding of the history of recycling in the Earth's mantle.

However, the greatest effort has been invested in developing new methods of dating diagenetic and hydrothermal assemblages, resulting in the realization that some of the recently held models of crustal fluid flow are not well substantiated. Alex's students and postdocs (named in parentheses) have shown that clastic diagenesis can be dated using Rb-Sr and Sm-Nd dating of clays and phosphates (Matthias Ohr), limestones can be dated using U-Pb even if remagnetized long after deposition (Charlie DeWolf), fluorites can yield extremely high precision Sm-Nd isochrons (John Chesley) and sphalerites can be dated using Rb-Sr (Shun'ichi Nakai). Furthermore, Chesley has produced the first comprehensive high resolution geochronological study of the history of pluton emplacement, granite cooling and mineralization in a batholith. Much of this research has been of a collaborative nature. For example the research on dating clastic and phosphate diagenesis is the direct result of forging a strong collaborative link with Don Peacor. Similarly the research on hydrothermal mineralization has benefited greatly from collaboration with Bill Kelly and Steve Kesler.

As well as these main lines of research, Alex has immersed himself and the lab in two important areas of research that largely stem from the initiatives of others within the Department. The first of these can be loosely described as studies in crustal tectonics and thermal evolution, and includes both pressure-temperature-time paths recorded in deep crustal terranes in collaboration with Eric Essene, Ben van der

Pluijm, Chris Hall, former postdoctoral fellow Klaus Mezger and graduate students Charlie DeWolf and Teri Boundy, and combined paleomagnetic, structural and geochronological studies of continental movements and terrane tectonics with Rob Van der Voo, Ben van der Pluijm, Chris Hall, and graduate students Joe Meert and Steve Potts. The second of these major collaborative efforts is best described as studies in paleoceanography and paleoclimatology and has included investigations of carbonates and phosphates with K.C. Lohmann, Lynn Walter, postdoctoral fellows Terry Quinn, Jim Zachos, Peter Holden and Charlie Jones and former graduate students Scott Carpenter and Paul Koch, studies of metalliferous sediments with Bob Owen and former postdocs John Davidson and Peter Holden, and the provenance of dust in the oceans with Dave Rea, Bob Owen and former postdoctoral fellow Shun'ichi Nakai. In addition to expanding these research endeavors the lab will soon engage in isotopic studies of ancient brines — the brain child of Lynn Walter and graduate student Anna Martini.

The lab has also taken on an inter-collegiate and inter-varsity collaborative research role. For example Geological Sciences graduate student Joe Graney has created a useful liaison between Alex and Gerry Keeler from the School of Public Health, and engaged the lab in studies of Pb pollution in the Great Lakes. Measurements of Li isotope enrichment with lasers, plasmas and microwaves are being developed by a Geological Sciences postdoc, John Christensen, together with Mary Brake and Ron Gilgenbach from Nuclear Engineering. Finally, the lab has been engaged in studies of high Ti Mare basalts with postdoctoral fellows Jim Paces and Greg Snyder from the University of Tennessee, the research being aimed at determining the role of a magma ocean in the development of the lunar mantle.

All of this serves to highlight the extraordinary level of collaboration and cooperation in high level geochemical research that has been possible with the personal and financial investment of The University of Michigan, the Department of Geological Sciences and various alumni and gifts from the Shell Foundation and Champlin Petroleum Company (Union Pacific Corp.). Five years ago Michigan had no reputation in radiogenic isotope geochemistry. It is now seen as having one of the world's major research facilities in this field.

Since arriving here in late 1986, Alex has won considerable recognition, both internal and external, and has served on a number of important committees. In these few years he has published 48 reviewed papers, 9 of them in the prestigious journals *Science* and *Nature*. In grants he has attracted more than \$2 million as a Principal Investigator. After 3 years at the University of Michigan he was awarded tenure, and after a further 2 years he was promoted to Full Professor. In 1988 he was appointed to the Michigan Memorial-Phoenix Project Faculty Executive Committee for the Ford Nuclear Reactor, a position that has just been renewed for a further 4 years.

Also in 1988 he was appointed to the National Academy of Sciences/National Research Council Committee on Status and Research Objectives in the Solid-Earth Sciences. In 1989 he was appointed to serve on the University of Michigan's Rackham Research Partnership Program Committee. From 1989 to 1991 he served on the Department of Geological Sciences Executive Committee. In 1990, the University of Michigan invited him to present a special seminar series on the subject of geological time to their alumni. Also in 1990 he was made an Associate Editor of the leading geochemical journal *Geochimica et Cosmochimica Acta*. He has just finished serving as a member of the University of Michigan's Inter-Collegiate Materials Advisory Committee. Since 1991 he has served on the National Science Foundation, Division of Earth Sciences, Instrumentation and Facilities Program as a panel member.

Having described all this, the best piece of news about Alex is that Christine and he just had their first baby, a wee chappie called Jamie. For the coming calendar year we will see less of them, however, because Alex has recently been granted sabbatical leave that will take them to Cambridge University and the Australian National University. During this time Alex hopes to develop isotopic techniques that should open up some exciting new research areas in radiogenic isotope geochemistry to keep the lab among the front-runners in innovative quality isotope geochemistry for several more years.

An Ancient "Cold Snap" Resolved

Theodore C. Moore Jr. and David K. Rea may be close to determining the cause of an abrupt global "cold snap" that occurred about 10,000 years ago as the climate was warming and glaciers were retreating across North America at the close of the last Ice Age.

Ted and Dave believe extreme fluctuations in Great Lakes levels, which at times reduced many of the lakes to mere puddles, are related to this 500-year-long global freeze.

Once their analysis of Lake Huron sediment core samples and seismic tracings is complete, they—together with several Canadian colleagues—believe they will be able to eliminate one of two competing theories on what happened between 10,000 and 11,000 years ago to chill out an otherwise warming climate.

Advocates of one theory maintain that a massive surge of glacial meltwater flowing into the North Atlantic lowered ocean and atmospheric temperatures enough to affect global climate. Other scientists believe ice water from melting glaciers became trapped in the Great Lakes region and that this intense local cooling was enough to trigger widespread climate changes.

Studying what happened at the end of the last Ice Age will help scientists predict the potential effects of rapid changes, produced by different factors, which are currently affecting Earth's climate.

Dave and Ted analyzed core samples and high-resolution seismic reflection studies of Lake Huron sediment layers, which they obtained during a 1991 expedition on the U-M research vessel *Laurentian*.

Using radiocarbon dating of wood samples and shells found in the sediment layers, they have dated four incidents of extremely low lake levels. The most recent occurred between 8,100 and 8,200 years ago. The second took place between 8,900 and 9,000 years ago. Lake levels fell again about 9,300 years ago. The lowest levels documented to date occurred between 9,700 and 9,900 years ago.

The net phase of the research will focus on isotope analysis of shells found in the Lake Huron sediments. "Glacial ice has a very different ratio of certain oxygen isotopes than rainwater, so we should be able to determine whether Lake Huron was full of glacial meltwater from the north or runoff from local creeks and rivers during this period of time," according to Dave.

New Research Scientist

Chris M. Hall (PhD 1982 U. of Toronto Dept. of Physics.) Chris has been an Assistant Research Scientist in the Department of Geological Sciences since July 1991. His research interests center upon the development of the $^{40}\text{Ar}/^{39}\text{Ar}$ dating technique. This includes using laser heating to measure ages in thin section with a high degree of spatial resolution. His work has involved pushing the limits of the method to both microgram sample sizes and to extremely young ages. He has also been involved in the use of $^{40}\text{Ar}/^{39}\text{Ar}$ dating as a thermochronometer, whereby time-temperature paths can be determined experimentally. Related to this is his interest in the mathematics of diffusion as it relates to isotopic systems, as well as the application of inverse theory to the whole field of isotope geochemistry.



University Embarks On Historic Capital Campaign

The University of Michigan in September kicked off the largest capital campaign ever undertaken by a public university. The goal of the campaign is \$1 billion over the five year period 1992-1997. States throughout the nation are finding an increasing gap developing between the infrastructural, social and educational needs of the state, and the revenues necessary to fund them. The major state universities have increasingly turned to tuition increases, federal research and education funds, and private philanthropy to maintain and enhance their educational programs. Michigan's new Capital Campaign has among its principal targets a new undergraduate educational center, enhancement of interdisciplinary activities between departments, schools and colleges, strengthening of graduate education and research, and endowment for faculty positions.

The Department of Geological Sciences is of course a component of the University Campaign, and has identified needs and goals that it hopes to achieve in the five year campaign. Particular areas targeted in the departmental campaign include a curricular innovation fund, a research initiation fund, graduate student fellowships, a field excursion fund, and a Camp Davis fund. The Department is working closely with the Alumni Advisory Board in formulating the Campaign, which will be formally announced in 1993. You will of course hear more about the Campaign in the coming months, both from the Department and as volunteers throughout the nation begin development activities on behalf of the Department. Stay tuned!

Alumni News

1930's

James L. Calver (AB '36, MS '38, PhD '41) was pleased to hear from Ernest Dobrovainy even though his address was incorrect in the July 1992 issue of Geoscience News. His phone call was like a 50 year reunion—it really “made my day!”

1940's

Dorothy M. Skillings (BS '47) writes that since an article in an earlier newsletter written by Dorothy, she and **Dolores Marsik Grammatikas** (BS '48, MS '49) have enjoyed a

lively correspondence. They would both be delighted if others of their class (1947) would write to them, either directly or through the Department. That includes those who were at Camp Davis in 1946, also. “Come on, let's hear from you all.”

John B. Hazelworth (BS '47, MS '49) retired from NOAA about 10 years ago. He was a research oceanographer. Three years ago he earned his masters license, and two years ago bought a sailboat and cruised it through the Bahamas, up the east coast, and then on the Great Lakes to Charlevoix, MI. He

wanted to cruise northern Lake Huron, North Channel, and Georgian Bay this past summer but couldn't find a crew, so his boat was tied to the dock. He didn't know Dave Rea and Ted Moore and all their graduate students were cruising those waters.

Mary Webster Lamoreux (BS '45) reports the birth of her third granddaughter and the entry of her grandson to the University of Maryland.

Nancy A. Rabe (BS '46) is enjoying her retirement. She just returned from Australia where she climbed the monolith, Ayers Rock, and saw lots of very old geological formations.

1950's

Frank M. Barnes (BS '51) worked for GMC for two years and then went with Hubbell, Roth & Clark, Inc., consulting civil engineers, in 1953. He became a registered engineer in 1960 and was elected V.P./Treasurer in 1962, retiring in 1991.

William J. Malin (BS '50, MS '52) has had a hard time retiring, doing it three times.

Chesley C. Herndon (MA '52) says that he has pursued those elusive puddles of oil and gas for over 40 years and, at age 65, still loves it. He thanks U-M for giving him such a great occupation and rewarding hobby.

Murray J. Copeland (PhD '55) winters in Austin, TX, from November through March. He uses the very good geology library at the University of Texas for continuing his paleontological research.

Gordon E. Bigelow (BA, '52) will be retiring to Ann Arbor in June of 1993.

John M. Ewing (MS '52) says he is pretty much retired, but on rare occasions there is some oil/gas consulting work.

Walter O. Kupsch (PhD '50), Professor Emeritus of Geological Sciences, University of Saskatchewan, received the Northwest Territories Commissioner's Award for Public Service at the Highest Level. He was Executive Director for the Advisory Commission on the Development of Government in the Northwest Territories, developed and managed a research group for the Legislative Assembly, and served as member and vice-chair of the NWT Science Advisory Board. He is Fellow and past Chair of the Board of the Arctic Institute of North America, and was Director of the Institute for Northern Studies at the University of Saskatchewan. Walter was saddened by the death of Abe Heinrich who made him feel at home in Ann Arbor in the post-WWII years.

Howard F. Bartlett attended U-M in 1958-59. He returned to the U.S. in June from Dakar, Senegal, West Africa after

working there for three years as project manager for Dupont Chemicals on Titanium Heavy Minerals Exploration & Development. He continues to consult for DuPont, working on Titanium in the Ukraine. He and his wife are enjoying being back in the U.S.A. and their new grandson in Utah. He sends regards to Bill Kelly. Howard was sorry to hear about the passing of Jim Zumberge, who he knew while at Michigan.

David E. Willis (MS '57, PhD '68) retired from UNOCAL International Oil & Gas in September and is now living in Richmond, Texas.

Eugene H. Freier (BS '54, MD '58) writes that he is still working full time as an emergency department physician.

David W. Plumer (BA '54) has become the Rector of the Anglican Parish of Meadows in Newfoundland as of November 1, 1992. He is serving about 550 families in three churches along the northern side of the Bay of Islands, Sunnyside, Meadows and Gillums. His wife has retired from her nursing career. David enjoyed seeing the pictures that Dr. Goddard supplied of 1955 Camp Davis but wonders if this could have been 1953 instead.

Peter M. Mann (BS '51) is presently living on Lake Michigan north of Leland after retirement from his law practice in Detroit. He and his wife hike extensively in the Leelanau, including the Sleeping Bear, have walked the entire shoreline perimeter of the County, and explored many of its lakes and back country features. Geology is a part of their daily lives. Although Peter never worked as a geologist, having been a photographer and lawyer, he has found that this education has enriched his life constantly.

1960's

Eileen M. Starr (BS '62, AM '63) has taken a position as Assistant Professor of Earth Science and Geography, as well as Planetarium Director, at Valley City State University in North Dakota, which is located in the Sheyenne River Valley.

Paul E. Myers (PhD '69) is teaching geology at University of Wisconsin-Eau Claire since 1969. Much of the past five years has been spent teaching in Scotland and Japan.

Ralph M. Perhac (PhD '61) retired recently as Director of Environmental Research from the Electric Power Research Institute in Palo Alto, CA. He is now working as a part-time consultant after having moved to Raleigh, NC.

Darwin R. Spearing (MS '64, PhD '69) took early retirement from Marathon Oil Co. this year. Both he and his wife work for a museum design firm doing designs and exhibits for science and other museums in Texas, Louisiana, and elsewhere. This is a tremendous career change and they find it very exciting and fun. Geology isn't forgotten—it's just being incorporated into this broader scope! Dar also points

out that some of the Camp Davis photographs were from 1964 (#4 and #7).

Paul Goldberg (MS '68, PhD '73) left Hebrew University of Jerusalem to take up a position of Research Fellow at the Texas Archaeological Research Lab, University of Texas. He is working on several projects involving geology and micromorphology and is still doing the geology of cave sediments in Israel, Turkey, and South Africa.

1970's

Robert D. Lattanzi (PhD '75) has spent 12 of the last 18 years working for Exxon in California and was promoted to Division Geoscience/Land Manager in January 1992. He's enjoying the land of fruits and nuts (CA)! He has fond remembrances of the Museum of Paleontology, the Museum Annex, and all his wonderful colleagues at Michigan.

Roger L. Gilbertson (PhD '72) is still working in Argentina and living in Buenos Aires—it sure beats Houston! He hopes to do more fieldwork in the Pre-Cordillera Andes from Bolivia to southern Chile. BHP's position in Argentina is growing—slowly, but growing. Roger hasn't been in Ann Arbor since July 1977 and is sure it has changed a great deal.

Gordon D. Wood (MS '73) writes that he does field work for Amoco Production Co. in Australia and France.

Richard J. Wagner (PhD '73) currently works for the Doe Run Company in southeast Missouri as Chief Geologist and Manager of Exploration and Mines Geology. This is 30 miles south of the barite district that he studied for his PhD dissertation.

1980's

David J. Krause (BS '62, PhD '86) is on sabbatical for the 1992-93 academic year here at U-M working with Nick Steneck of the history department (who, with Steve Kesler, was co-chair of his dissertation committee). He will be looking at the early history of the department and also at the important but largely unacknowledged role that science generally played at U-M in the mid-1800s. A book based on his dissertation work (*The Making of a Mining District, Keweenaw Native Copper 1500-1870*) will be out later this year.

David P. Moecher (PhD '88) is starting his second year at the University of Kentucky at Lexington, the boyhood home of his PhD advisor, Eric Essene. For those of you who hadn't heard, Eric received yet another award—election to the Lafayette High School "Hall of Fame." Eric was unable to be there to accept the award, so the honor of accepting for him fell upon Dave's shoulders. Quite a coincidence that one of his students ended up there! Dave and his family (Amy and sons Patrick and Tom) enjoy Lexington and the bluegrass. They bought a home last June and find home-ownership wonderful (compared to renting for 18 years!).

Ra Eldridge (MS '85) has been working for BP Exploration in Alaska for over six years, but the end is in sight! In May of 1994 she will leave the company as part of a voluntary severance package. She and her husband need to decide what they are going to do in their post-oil industry years, so their friends have 11/2 years to visit Alaska with a free bed!

John Craddock (PhD '88) and his wife became parents of Cara Warren Craddock on March 30, 1992, in St. Paul, MN.

Margaret J. Hastedt (BS '84) recently joined ODP as a marine technician for the paleomagnetism lab onboard the JOIDES Resolution. She enjoyed sailing on Leg 144 in the south Pacific and looks forward to working with Bernard Housen of U-M during Leg 146. She can be reached at Hastedt@drake.tamu.edu on the ship, or Hastedt@nelson.tamu.edu at ODP. Go Blue!!

Christopher P. Weiss (BS '85) has been at Glacier National Park as a naturalist for four summers. He also helps the park as a geologist/consultant for redoing all the roadside exhibits. Free time means hiking, and he's now done over 60 peaks in Glacier. He began this fall as a chemistry/math teacher at Whitefish H.S., in Whitefish, MT, and is especially enjoying teaching chemistry and being home in the mountains. Next summer he will take the summer off from Glacier to finish getting his teaching certification. Chris would like to have friends visit. Future plans are to buy a piece of land and live in Montana's Flathead Valley for many years to come.

Scott D. Stihler (BS '82) received his Master's degree from the University of Alaska Fairbanks in December 1991. A paper based upon some of his thesis work should come out in *Geology* within the next couple of months. At present he is working for the USGS at the Alaska Earthquake Information Center, Alaska Volcano Observatory, where he primarily locates regional and volcanic events. Scott sees former U-M graduate student Doug Christensen almost every day and gives him a hard time whenever possible ("somebody's gotta do it").

James L. Folcik (BS '82, MS '84) and wife Nancy would like to announce the birth of their first child, Jared Connor, on August 26, 1992. Mother and baby are fine. Father is just trying to hang on in the game of musical chairs that is the oil business.

1990's

Antonio Arribas (PhD '92) writes that he is living in Japan (one hour from Tokyo) and loving it. Work at the Geological Survey of Japan is going great and involves research on active geothermal systems in Hokkaido and on fossil hydrothermal deposits in the Philippines. Miguel started going to Japanese kindergarten and, by the time this newsletter is out, he will probably speak Japanese better than Antonio will ever be able to. Guillermo (6 mos.) is still quite confused about his whereabouts. Antonio would like visitors!

An Indonesian Experience



The following article has been condensed from a longer memoir by the author which appeared as a chapter in The Oil Finders, a book published by the American Association of Petroleum Geologists in 1992. We found the saga fascinating and with AAPG's and Don Todd's permission share parts of it with you.

Donald F. Todd (BS '50)

In the fall of 1963, my friend Patrick J. McDonough read an Oil and Gas Journal article reviewing world production statistics. News of Indonesia intrigued him. Our venture started simply with his saying, "Damn it, Todd, let's go to Indonesia!" I had plugged a favored central Montana prospect the previous day, and I was ready for a change even though I hardly knew where Indonesia was. Montana was (and remains today) a difficult place to make it in the oil industry. In 1963, \$2.25 oil and 6-cent gas didn't help. Pat went to Indonesia in early 1964. I stayed at home, continuing to research the geology, production history, and cultural background of this fascinating area.

Indonesia had a long oil history. Northern Sumatra was the birthplace of Royal Dutch/Shell as an oil company in 1883. Prior to World War II, 2% of world oil production came from Indonesia. Production was shallow. Many excellent fields were less than 4,000 feet deep, and the average depth was only 1,800 feet. Shell, Stanvac, and Caltex were responsible for nearly all of Indonesia's production in the pre- and post-war years. The 1949 revolution in Indonesia ended 300 years of Dutch rule. President Sukarno, a strong, adventurist leader, ruled under what he termed "guided democracy." The PKI party, affiliated with the Chinese communists, became a more and more dominant influence on Sukarno's PNI party and Indonesia.

The political climate was becoming increasingly difficult for foreign businesses. Few western companies bothered to even look at Indonesia. Oil, rubber, and a few other industries with pre-war ties endeavored to continue under adverse conditions. In late 1965, Shell gave up and sold out. Against, this unpromising backdrop, Pat, Larry Barker, and I formed our company in the spring of 1964 and sought an Indonesian oil exploration contract. Larry was president, I was executive vice president and Pat secretary-treasurer. Pat picked the name Independent Indonesian American Oil Company, known as IIAPCO for short. None of us had any previous involvement in foreign exploration. Our industry efforts had been focused in the northern Rockies.

We decided that political unrest, lack of a good road network, a tropical jungle environment, and a dense population precluded most onshore areas from consideration. We were also aware that initial seismic exploration would be faster and cheaper offshore. This was important to IIAPCO, a company short on finances. I had selected four areas of interest: the eastern Kalimantan offshore, the southern Kalimantan onshore portion of the Barito Basin, the offshore area around Madura Island and offshore Northwest Java. We had no detailed information on any of these areas, but hoped to obtain geologic data in Indonesia that would help refine our final area selection. What little was published on western Java geology indicated that the Sunda shield (effective basement) would be encountered a few miles offshore. IIAPCO did not concur with this thinking. We felt the lack of geologic consideration given the area by others would be of advantage to us in negotiations. Little interest had been expressed in Indonesia's offshore. Since this offshore area was physically and politically remote from the mainland, we believed that this would lessen our political problems.

Pat and I headed for Indonesia in June 1964 with little more than plane fare in our pockets. We never considered we might not succeed. We island-hopped across the Pacific and Southeast Asia: Hawaii, Wake, Guam, Manila, Saigon, Singapore, and finally Jakarta (this was before 747s.) Our American contact in Indonesia on this trip and the next was Bill Palmer, a representative of the American motion picture industry and a friend of President Sukarno. However, the PKI, the Indonesian communist party, thought Bill to be a CIA representative. "GO HOME BILL" slogans were everywhere.



On our first trip, we met with Third Deputy Premier Chaerul Saleh, one of President Sukarno's top men. We were favorably received and given approval to negotiate a Contract of Work with the Ministry of Basic Mining, Oil and Natural Gas, and with Permigan, an oil company controlled by the Indonesian Communist Party. We borrowed two typists from USAID, and with a copy of Pan-American's 60-page Contract of Work as a guide, we endeavored to draw up our own. Pat thought we should have the contract finished and approved in a week.

While the Indonesians reviewed the first draft, we decided to take a few days to see Java. Near Ceribon, near IIAPCO's proposed area and on the flank of a large volcano, we happened upon two old permanent derricks in the Bongas Field. We found someone to open these wells for us. One well drilled by Shell in 1941 was capable of flowing 40 barrels of oil per hour (BOPH) of 40 API oil. The other, drilled in 1939, was capable of flowing 25 BOPH. Pat and I were now sure we had selected the right area.

Communications from Jakarta were difficult at best. As Indonesia was on bad terms with nearby Malaysia, we couldn't go to Singapore to call the U.S. This necessitated a 6000-mile round trip to Bangkok in early July, just to make a phone call. Even then, radio phone connections were bad. Pat was frustrated and decided to return to the States.

When I got back to Jakarta, I tried to speed up negotiations. Saleh's lawyer informed me that as IIAPCO was seeking a 30-year contract, a three or four-day wait now and then shouldn't hurt a bit! The true concept of patience was first introduced to me by the Indonesians. I was glad Pat had gone home. These gentle people didn't understand Pat's hard-drinking, big-hearted, but impatient and brusque nature. Finally, I was told we would have to agree on a bonus before any contract would be approved. I returned to the U.S. at the end of July to meet with my associates in an endeavor to meet the Indonesian demands. We began working on a revised contract.

It turned out Permigan wanted a \$3,000,000 bonus. I sent a message back that we had anticipated a request for a token bonus, not one that would finance the country. We gave them the short course on how independents work. Although independents were always short of capital, we explained, they often reached the finish line before the major oil companies! In mid-September, we sent a revised contract draft offering a \$300,000 bonus. The Indonesians found the offer offensive but indicated they were willing to negotiate. In December 1964, we received a cable inviting IIAPCO back to finalize the contract. All we had to do was come to a compromise on the bonus.

In January 1965, Sukarno announced that Indonesia was withdrawing from the United Nations. There was evidence that Sukarno had formed a working alliance with Red China to force the Anglo-American presence out of the area. Sukarno had recently told the U.S., "To hell with your aid." In spite of these confusing and disturbing actions, I decided to return as planned. Still broke, but with 70% of our costs covered, IIAPCO returned to Jakarta in mid-February 1965. Enroute I learned that the U.S. Information Service (USIS) in Jakarta had been taken over and the American flag destroyed. This was followed by a takeover of another USIS office in Medan, Sumatra.

The atmosphere in Jakarta was one of some desperation. I arrived in Jakarta only to be invited to a cocktail party for departing U.N. personnel. It was difficult to obtain any meetings with Permigan and Indonesian government representatives. However, I was still optimistic that I would have a contract signed within two weeks. When I met with Saleh's lawyer to discuss the bonus, he indicated that Indonesia would not accept our \$300,000 offer, and I told them IIAPCO wouldn't accept their \$3,000,000 proposal. I said that our top bonus offer would be \$1,000,000 in exchange for certain changes in the contract. The Indonesian economy was so bad that I hoped they might accept this offer even though I knew that Pan-Am had paid a \$5,000,000 signature bonus when they signed in 1962.

Inflation was rampant. The oil companies could get their rupiah (Rp) only at the official rate of 45 Rp to the dollar, while the black market rate in early February reached 15,000 Rp to the dollar. It was necessary to carry a briefcase full of rupiah just to go to a Chinese restaurant for dinner. Gasoline purchased at the black market rate of exchange was about one cent per liter. You could purchase 250 liters of gasoline for the cost of one whiskey sour at the Hotel Indonesia. Meanwhile conditions were rapidly deteriorating into a serio-comic version of *The Year of Living Dangerously*. A few days later, Bill Palmer's dog was kidnapped and held for ransom. Americans were being verbally insulted in the streets. On February 26, twenty-one newspapers and magazines were shut down. Everywhere the Indonesian Communist Party (PKI) was flexing its muscles. Dramatic changes for the worse were evident from the time of our previous summer trip. Political turmoil made me a hotel prisoner. To pass the time, I requested permission to review Permigan's geologic files on the adjoining onshore area. I was told that this would be permitted only after a contract was signed.

The Indonesians are intelligent, delightful and friendly people with a keen sense of humor, and their family relationships are more like our own than elsewhere in Asia. I continued to call on Basic Mining and Permigan officials, and began to visit them at home and meet their families. These close relationships were to prove most beneficial after the aborted September 30, 1965 coup.

On March 1, 1965, First Deputy Premier Subandrio asserted that Indonesia's policy of confrontation would continue. Communist-led demonstrators took over the U.S. rubber plantations and factories. Newspapers were calling for the arrest of Bill Palmer, claiming he was a CIA agent. There was a call for all American newsmen to leave. Five hundred demonstrators entered U.S. Ambassador Howard P. Jones' residence. I had returned to Indonesia at the government's invitation, yet after a month, I had not had a formal meeting with them. I had, however, learned patience and I remained determined to go home with a signed contract. Indonesian offices closed at 2:00 p.m. After that, foreigners staying at the nearly empty Hotel Indonesia congregated at the swimming pool to exchange tales. I met a displaced Czechoslovakian-U.S. entrepreneur who dealt in everything from human hair for wigs, to quinine, and drill bits. "Politics is lousy," he commented, "but business is goot." I reflected on a statement I had read when first considering this Indonesian venture: "better to have an area of good geology and sorry politics than good politics and sorry geology."

IIAPCO's refusal to pay a large bonus combined with the current political unrest had changed the game. I informed them that they needed the expertise of people like me to help bring Indonesians into the oil industry. They replied that they would like to hire me if my price wasn't too steep. On March 10, 1965, I cabled home: "OLD DEAL HAS BEEN THROWN OUT. THEY NOW WANT IMPOSSIBLE PROFIT SHARING. AM TRYING TO PULL IT OUT BUT DOES NOT LOOK GOOD." That was the understatement of my life. Everything had blown up. Shell was given 48 hours to appoint an Indonesian director. Association with Americans was becoming difficult for Indonesians. A PKI rebellion in Surabaya resulted in the shooting of 17 navy officers. I decided it was time to pack my bags and go home, my dream of IIAPCO's contract shattered. We could only be thankful we hadn't spent \$25,000,000 as Pan-Am had on their contract.

In time, the chaotic political weather in Indonesia began to clear. In February 1966, Dave Dodge encouraged me to consider going back to Jakarta for another try. On June 7, 1966, about the time I was scheduled to leave for Jakarta, IIAPCO received a cable from the U.S. Embassy: "IN LIGHT RECENT REPORTS CONCERNING STATUS GENERAL IBNU SUTOWO. EMBASSY SUGGESTS TODD DEFER TRIP PENDING FURTHER DEVELOPMENTS." It was a disquieting communication, but I set out for Indonesia anyway, after waiting a week and conferring with my associates.

Indonesia was still in a state of confusion and unrest. There had not been any contract signed with foreign investors in any industry since the aborted coup nine months earlier. Although the U.S. Embassy was generally pessimistic about IIAPCO's chances, they remained cordial and helpful. Because normal communication channels were difficult and time consuming, embassy staff agreed to open the diplomatic pouch to us to send contract drafts to the U.S.

Demonstrations were common. Gun-toting soldiers, armored cars and barbed-wire barricades were everywhere, and uneasiness and unrest continued. Jakarta, a city of 4.5 million, (it is now 8.5 million) had but one traffic light. It was one huge traffic jam with people, dogs, betjas (bicycle-taxis), cars, and trucks all in the same place — in front of my taxi. By mid-July, however, President Sukarno's authority to issue decrees was rescinded, the Malaysian confrontation was officially ended, and an application for re-admission to the United Nations was being made. Sukarno was stripped of his lifetime presidency. The PKI, the third largest communist party in the world during my 1964 and 1965 trips was now virtually wiped out.

Permigan, the company IIAPCO previously worked with, had been liquidated because of its PKI affiliations and replaced by Permina. The "GO HOME YANKEE" signs were gone now, replaced by anti-communist slogans. In our meetings, I reviewed previous contract proposals. After spending time with Mr. Kwa of Permina discussing changes and additions, I met with the

full Permina team. The fact I was alone and negotiating with four men from Permina actually turned out to be an advantage. IIAPCO's first draft was submitted July 12.

IIAPCO was extremely fortunate that groundwork had been laid during a period when Western business wanted little to do with Indonesia. I returned at a time when Permina and Indonesia needed a Western guinea pig on which to try out their new business desires and intentions. IIAPCO's luck should be attributed to a little foresight, a bit of naivete, the optimism of youth, and the encouragement of my associates.

Many of the late contract changes were mainly for public consumption in this proud, emerging nation. We replaced "IIAPCO shall keep the books" with "Permina shall be responsible for keeping the books... however Permina shall delegate to IIAPCO its obligation to keep books." "IIAPCO shall...and Permina shall approve" was included frequently for this reason.

On August 18, I arrived at Permina's office to discuss a few last changes. With three flustered Permina secretaries in tow, we proceeded to draw the final contract. I went into a room by myself, and with nothing to read, chewed my fingernails. We were done by 2:00 p.m. I was hustled into a car and taken to a Permina official's home. He handed me a pen and I signed. The next day I sent a telegram to Larry Barker. It read: "CONTRACT SIGNED BY ME YESTERDAY AND GENERAL THIS MORNING. COULD NOT WAIT YOUR REPLY. SIGNING BECAME URGENT. USED MY BEST JUDGEMENT. HOPE YOU APPROVE. CHEERS." At times this seven weeks seemed like seven months. Today, it takes seven months or even two years to obtain a contract. The contract between Permina and IIAPCO became the worldwide model for production sharing commonly used today.

This contract entitled Independent Indonesian American Petroleum Company (IIAPCO) to explore 14 million acres of Offshore Northwest Java. IIAPCO subsequently was awarded an adjoining 32 million acres called Offshore Southeast Sumatra. Together, these areas totaled 72,000 square miles, comparable in area to the state of Oklahoma. Since the beginning of production in 1971, through the end of 1990, 1,750,000,000 barrels of oil, LPG, and gas equivalent have been produced from these areas. There are more than a billion barrels of proven remaining reserves. Current production is 420,000 barrels of oil and gas equivalent per day.

In October 1985, Pertamina and the Ministry of Mining invited my wife and me to Jakarta to help Indonesia commemorate 100 years of petroleum development. The ceremonies were opened by President Suharto. At a dinner held October 8 for 2,500 people, sixteen honored guests were awarded Pelopor (Pioneer) gold medals by Minister of Mining and Energy Professor Subroto. Eight Indonesian, three Japanese, and five Americans received this award.

My Pelopor award read: "Based on his expertise as a geologist, in 1964 he was successful in convincing the Indonesian oil experts that both onshore and offshore areas of the northern part of West Java had a significant oil and natural gas potential (reserve). His pioneering and success as the first Production Sharing contractor between Pertamina and IIAPCO in 1966 in the Indonesian offshore areas of the northern part of West Java pushed the efforts for the exploration of oil and natural gas in other offshore areas, which in a relatively short period proved to be able to increase Indonesia's oil and natural gas production."

Don Todd is currently living in Friday Harbor, Washington.

Alumnus Profile

Donald F. Todd

Born in 1925, Donald F. Todd attended the University of Michigan and obtained a B.Sc. degree in Geology in 1950. After a year of geological consulting in southern Kentucky, he took a job with Stanolind in Billings, Montana. In 1952, however, he became an independent geologist in Billings and established Tyler Oil together with Larry Barker. In 1964, he embarked on an "Indonesian Experience" (see accompanying article) and became Executive Vice President of a newly established company, called the Independent Indonesian American Oil Company (IIAPCO). Some "years of living dangerously" followed, but they were crowned by many exploration successes in Indonesia. In 1985 Mr. Todd was awarded the Pelopor (Pioneer) Gold Medal by the Indonesian Minister of Mining and Energy, at the occasion of Indonesia's commemoration of 100 years of petroleum development. This past year, the American Association of Petroleum Geologists awarded Donald F. Todd the Michel T. Halbouty Human Needs Award (see AAPG Bull., July 1992, p. 1062). Don and his wife Nancy are patrons of the arts in the Denver area, and Don spends his semi-retirement years as a Sunday artist. Their five children are now in their 30's and 40's.

Honors

Alumni

Walter O. Kupsch (PhD '50) received the Northwest Territories Commissioner's Award for Public Service at the Higher Level.

Donald F. Todd (BS '50) received the Michel T. Halbouty Human Needs Award from the American Association of Petroleum Geologists.

Stewart Wallace (MS '48, PhD '53) was elected President of the Society of Economic Geologists.

Faculty

Bill Farrand was elected Fellow of the American Association for the Advancement of Science (AAAS).

Rob Van der Voo received the 1992 G.P. Woollard Award from the Geophysics Division of the Geological Society of America.

Bob Owen, Ben van der Pluijm and **Rob Van der Voo** each received a 1992 U-M College of LS&A Excellence in Education Award.

Alex Halliday received the first (1992) U-M Geoalumni Award for Excellence in Research and Teaching.

Eric Essene was finally elected to the Lafayette High School "Hall of Fame" (KY).

Students

The Geological Society of America awarded **Anna Hook**, a Michigan undergraduate geology student, a "Top Senior" travel grant that included free meeting registration, a copy of the abstract book, and five nights of hotel accommodation at the October Cincinnati meeting. The Department matched this by providing free transportation. Ben van der Pluijm and Lynn Walter had nominated Anna for this award.

1992 GSA grants with special mention went to Michigan graduate students **Teri Boundy, Jay Busch, Tracy Frank** and **Nei-Che Ho**. Others who received grants were **Bernie Housen, Alfredo Leon-Gonzales, Anna Martini, Jack Zaengle**, and **Xiaoyuan Zhou**.

Faculty, Research Staff, and Student News

Besides continuing work on Cyprus and the Marianas, traveling to various ODP panel meetings, and spending three weeks at Camp Davis this summer, **Jeff Alt** has been busy organizing Leg 148 of the Ocean Drilling Program, which will return to Hole 504B in the eastern Pacific. This is currently the deepest scientific drillhole in the seafloor and will be drilled even deeper upon the return of the drillship in January (nice time of the year to be on the equator). Jeff also travelled to California to participate in an IGCP meeting and field trip examining low-grade metamorphism of submarine arc rocks, which is pertinent to a new project studying submarine volcanics from the Mariana forearc, and plans for an upcoming cruise to study submarine mineralization in the western Pacific next year.

While on sabbatical at the University of Lausanne, **Eric Essene** spent ten days in Norway with **Teri Boundy** (PhD '95), **Mike Cosca** (PhD, '88), **Klaus Mezger** (postdoc '90-92), **Rosemary Sliney** (MS '88), **Joyce Budai** (PhD '84) and sons **Adam** (PhD, vertebrate paleo, '16) and **Zachy** (BA, foreign relations, '09). Several days were spent in the Bamble Sector looking at the Norwegian continuation of the Grenville Terrane in North America. Håkon Austrheim of the Geologisk Museum joined the group on the island of Hølsnoy north of Bergen to visit the spectacular Caledonian eclogites forming in Grenville granulites. In one of the rainy portions of the world, the sun shone unremittingly for the entire trip, making it a beautiful and thirsty experience. Klaus and Mike will be dating the timing of metamorphism and cooling rates in the Bamble area with Eric. Teri and Klaus will be obtaining chronological data with similar techniques on mineral separates from Hølsnoy eclogites and associated amphibolites. Eric also took two trips to the Italian Alps with Mike Cosca, **Zach Sharp** (PhD '88), Hannes Hunziker and other Lausanne faculty to see Alpine eclogites, blueschists, eclogite facies granites and coesite-pyrope whiteschists in the Dora Maira massif. Some of the pyrope crystals are 0.2 m across, and they are 99% end-member pyrope. Zach has a paper in press with Eric on isotopic and petrologic studies of these whiteschists.

The Grenville of North America wasn't wholly neglected, as Eric spent a few days in Canada examining the Robertson Lake mylonite zone with **Jay Busch** (PhD '95). They were supposed to meet up with **Jodie Hayob** (PhD '93) and **Mark Rathmell** (MS '92) at the Sharbot

Lake Campground (a justly famous place for mating dances between loons and **Steve Bohlen**, PhD '79), but Jodie and Mark hid in the bushes for two days to avoid all contact with their advisor. This fall Eric and six graduate students took a field trip to the Adirondacks, visiting locales near Balmat, Harrisville, Edwards, Wanakena, Lake Placid, Lewis, and Gore Mtn while camping at the Gouverneur Rod and Gun Club. This is the 18th anniversary of Eric's first field trip to the Adirondacks with grad students (see last newsletter).

Two other grads, **Charlie DeWolf** (PhD '92) and **Ed Van Hees** (PhD '94) are continuing work on Archean metamorphic and geochemical problems. Charlie has just punted to England to undertake SIMS Pb isotope studies of zoned monazites with **Keith O'Nions**; he is now in Mainz visiting Klaus and Max Planck. Ed Van Hees is investigating gold deposits at Lupin, NWT, and Timmons, Ontario. Among other projects, Ed is evaluating the timing of gold deposition.

In addition, Eric has continued mineralogical and TEM/AEM collaborations with Don Peacor and his students. **Geijing Li** (PhD '94) has a paper in press to the American Mineralogist with **Dave Brosnahan** (MS '77), **Dick Beane** (visiting Prof. '85-87), Don and Eric on two new alunite group minerals. **Wei-Teh Jiang** (PhD '93) has just submitted a paper on the stability of illite solid solutions to Clays and Clay Minerals with Don and Eric. Although in large part mineralogical, portions of these papers address solid solutions and phase equilibria.

Eric is looking forward to the arrival of a new NSF postdoctorate fellow, **Jerry Magloughlin**, in January 1993. Jerry is finishing his dissertation at the University of Minnesota, where he has been working with **Larry Edwards** (MS '86). Jerry plans to apply chronological measurements to studies of major Grenville mylonite zones, which will interface well with ongoing work of Eric and his colleagues. The use of chronological techniques for metamorphic studies is clearly becoming a regular part of research undertaken by Eric with students and colleagues.

Bill Farrand has been on the go as usual this year. In June he and his wife once again accompanied the U-M Alumni tour to see Alaskan glaciers. In July his archaeological connections took him to a meeting in north-central Spain sponsored by the Spanish Natural History Museum. One of the highlights was slithering through narrow karstic passages and down cable ladders to examine the co-occurrence of early humans and cave bears. This was followed by three weeks in central Turkey where he and colleagues from UC Berkeley

searched for Lower Pleistocene hominid sites, without notable success, but they saw some promising localities to be revisited. In February '93 Bill will accompany U-M colleagues to Egypt for one final season surveying prehistoric sites in the Eastern Desert.

Several kudos came Bill's way this year. He was elected Fellow of the American Association for the Advancement of Science (AAAS), and he is President-Elect of the American Quaternary Association (AMQUA). Last but not least, Bill gained TV fame by appearing on NOVA's presentation "In Search for the First Americans," where he explained the mysteries of the famous Two Creeks Forest Bed on the shores of Lake Michigan.

Dan Fisher has been pursuing his usual range of projects from echinoderm crystallography to the methodology of phylogenetic inference, but the largest chunk of his time in the past six months has focused on a surprising development on the mastodon front. While excavating a late Pleistocene mastodon site near Ann Arbor, he and his crew of volunteers encountered a trackway of a full-grown male mastodon (not the same individual whose bones they were recovering). The footprints had been made as the animal walked along in the shallow water of a late Pleistocene pond; they were impressed into a compact, clayey sand unit, overlain by a light, shell-rich



marl. The trackway was excavated by painstakingly exhuming the sand-marl interface. Since each footprint was about a half meter across, and at a depth of about a meter and a half below the surface, following the trackway was a major undertaking. Nonetheless, it became evident that this was one of the longest and best preserved fossil elephant trackways in the world, providing a record of behavior and body weight that will be extremely useful in studies of mastodon paleobiology and extinction. The trackway itself will eventually be reburied in order to preserve it, but as a permanent record of a portion of it, Dan and crew made a fiberglass mold of one ten-print section. This measures 12x2 meters and weighs about a thousand pounds, but even such numbers barely do justice to this graphic record of a few moments out of the late Pleistocene.

Bill Kelly is now in his fourth and *FINAL* year as the University's Vice President for Research and will return to the Department for his retirement furlough in 1993-94, actually retiring on June 1, 1994. While he has found this latest official duty at the University a fascinating one (i.e., a good way to "pay dues" and "flame out"), it has carried a painful price, chiefly in near total severance from the Department. But that last year, '93-'94, will be an opportunity to restore the old friendships and to write up a few manuscripts that had to be put on a back burner. Anna and Bill plan to remain in Ann Arbor in retirement, using this as a base for all sorts of long-deferred adventures and hopefully some continued association with the Department.

Steve Kesler was on sabbatical leave from January to May, during which he finished the first draft of a book entitled Mineral Resources, Economics and the Environment. As part of the research for the book, Steve visited South Africa in March to get a first-hand impression of the geologic, social and political factors that might affect its future role as a major mineral supplier. During a month of travel, Steve visited the Witwatersrand gold deposits, chromium, platinum and fluorite deposits in the Bushveld Complex, and the Kimberley and Cullinan diamond mines. He also visited and lectured at Witwatersrand and Rand Afrikaans Universities, as well as the research division of several mining companies in Johannesburg. In April, Steve was one of six speakers at the Mineral Deposits Research unit symposium on the future of research in economic geology at the University of British Columbia. During the summer, Steve and **Torsten Vennemann** visited the Mochito lead-zinc-silver chimney-manto deposit in Honduras, where Rodrigo Vazquez is working on his thesis. To round things out, Steve joined the Geochemistry and Petrology panel of NSF this fall, a job

that requires reading over 100 research proposals for each of the two annual meetings.

Becky Lange survived her first Michigan winter and thoroughly enjoyed her first year in the Department. She was given a light teaching load, allowing her to spend the months of April and May at the University of Chicago in the experimental petrology laboratory of Professors Bob Newton and Julian Goldsmith. That opportunity allowed Becky to get started on some high pressure experiments while waiting for the renovations of the new High Pressure Experimental Petrology Laboratory in C.C. Little (shared with Youxue Zhang) to be completed. In June, she headed west and spent three weeks with students **Sharon Feldstein** and **Jean Tangeman** in eastern California helping them get started on the field aspects of their PhD theses. Later in the summer, Becky spent two weeks teaching at Michigan's field camp in Wyoming. The start of the 1992-93 academic year was dominated by efforts to set up an apparatus for making density measurements of silicate liquids; the goal is to examine the effect of Al^{3+} , Ti^{4+} , and Fe^{3+} coordination change. Don Peacor has been most generous in allowing Becky to temporarily move into his laboratory space.

The Organic Geochemistry Group directed by **Phil Meyers** has grown this fall by the addition of two new graduate students, **Beth Kowalski** from Notre Dame and **Gabrielle Tenzer** from Yale. Beth will be working on several areas in marine geology, including aspects of the K/T boundary extinctions and changes in Pleistocene sedimentation types at glacial-interglacial transitions. Gabrielle is interested in environmental geology. She will be looking at recent sediments from the Great Lakes and in Nevada.

Phil continues to work on Pyramid Lake, Nevada. The sediments of this lake record the history of climate changes in the eastern Sierra Nevada and the arrival of logging and mining activities in the late 1800's. He participated in a coring expedition with individuals from UC Berkeley, UC Davis, and USGS Denver in June. One of the noteworthy results of that trip was recovery of 24 m of push core from the lake, which is expected to yield a 35 Ky record. Another noteworthy aspect was the experience of being caught on the lake in one of the wind storms for which the area is famous. After the small boat was blown ashore, Phil had to jog three miles in the storm to find help. What a way to exercise!

As part of his NSF-funded project to study the organic geochemistry of the K/T boundary, Phil sampled

boundary outcrops in the I-25 roadcut at the Raton Pass in April with help from **Chuck Pillmore** and **Joe Hatch** from USGS Denver. While there, he and **Bernie Simoneit** from Oregon State also collected samples of a Trinidad Fm coal seam that had been partially coked by an igneous intrusion. These samples should give some interesting information about thermal alterations of organic matter under natural, but controlled conditions.

Jim O'Neil spent a hectic but very rewarding summer. In July he participated in the 7th International Symposium on Water/Rock Interaction (Park City, Utah) where he presented one of the keynote addresses. In August he went to the University of Lausanne to present a paper coauthored with **Greg Arehart** (PhD '91) at a symposium on isotope geology and remained in Lausanne for about two weeks working with **Zach Sharp** and visiting with other U-M notables there and nearby: **Eric Essene**, **Joyce Budai**, **Mike Cosca**, **Rosemary Sliney** and **Klaus Mezger**. Jim then went to the University in Nancy to make preliminary ion-microprobe measurements of deuterium variations that occur over micron distances in synthetic hydrous materials prepared by **Torsten Vennemann**. During the past year, Torsten and Jim discovered that hydrogen isotopes exchange extremely rapidly between minerals and molecular hydrogen and are trying to understand the mechanism of these important exchange reactions. After two days of R&R in Paris, Jim continued on to the University of Barcelona where he presented a grueling 20-hour course on "Stable Isotope Geochemistry of Low-Temperature Processes" in five days.

Bob Owen participated as a shipboard scientist in Ocean Drilling Program Leg 145 (Hokohama to Victoria). One of the highlights of the cruise was the recovery of ferromanganese nodules of Miocene age at depths of 50-70 meters below the seafloor. Geochemical analysis of these nodules should provide clues to changes in ocean chemistry during the late Miocene. Bob received the LSA Excellence in Education award. He took his entire family to field camp for the first time. Susy loved it, Ryan ate everything in sight, and Timothy received expert instruction in the use of firecrackers and rockets from Skip Simmons.

Don Peacor says that shales and clay minerals, when looked at in the right way, are beautiful(!), and he is continuing to have fun working out some relations that we wouldn't have dreamed of just a few years ago. **Fernando Nieto** (University of Barcelona) spent a sabbatical year working on shales and clays from Spain

and obtained a wealth of interesting data. **Bob Freed** visited Don on several occasions, continuing to work on new insights into diagenesis of Gulf Coast shales, and we were delighted that Dick Merriman and Brin Roberts were able to return for a month's visit; we're all collaborating on a TEM project with Peter Arkai of Hungary that concerns chlorite crystallinity; Peter should be here in the near future. **Wei-Teh Jiang** and **Gejing Li** visited Japan and gave papers at the IGC; Wei-Teh is finishing his thesis work now, getting ready to take a post-doc position at Arizona State. **Yen Hong Shau** finished his thesis work on trioctahedral phyllosilicate diagenesis in marine basalts and has taken a position at Sun Yat-sen University in Taiwan—as an oceanographic geologist! **Matthias Ohr** has also finished up his thesis work with some remarkable results on radiogenic isotope studies of shales in conjunction with Alex Halliday. **Nei-che Ho** continues his work in cooperation with Ben van der Pluijm, **Hailiang Dong** with Alex Halliday, **Vicki Hover** with Lynn Walter, and **Weixin Xu** with Rob Van der Voo, and Don's been busy with papers for the MSA short course on TEM in mineralogy and the editorship of *American Mineralogist*.

The year 1992 began with such disappointment in the Rose Bowl that **Henry Pollack** decided to go a long way away and left the next day for Antarctica, to join the staff of the World Discoverer on a three week expedition to the Antarctic Peninsula and the Falkland Islands. The penguins, seals, gulls, skuas, and hump-back whales were truly fantastic and make one appreciate the special characteristics of Earth's remote places. In late February Henry testified before Senator Al Gore's Senate Committee on Commerce, Science and Transportation presenting perspectives on the Earth's climate over the past 500 years as inferred from borehole temperature profiles. The ongoing borehole temperature investigation took to the field in July, when Henry and colleague **Ed Decker** from the University of Maine located and logged seven boreholes in New York and New England drilled in the early 1960s for heat flow determinations. The remeasurements revealed significant changes in the temperature profiles likely related to changes in the hydrological regime and the surface temperature over the past three decades. Two PhD students, **Andy Nyblade** and **Suzanne Hurter**, completed their degrees and have embarked on their next career steps. Suzanne has returned to her position as assistant professor of geophysics at the University of Sao Paulo in Brazil, just in time for the unrest associated with the impeachment proceedings against the President of Brazil (shades of Watergate!). Andy won a prestigious NSF post-doctoral position

which he took up at Penn State, where he is about to set forth on another expedition of fieldwork in the East African rifts. Newly arrived in the U-M Geothermal Laboratory as of October is **Shaopeng Huang**, a post-doc from the Institute of Geology in Beijing. At the December AGU meeting Henry organized a Union Symposium in memory of Francis Birch, Henry's own post-doctoral mentor at Harvard, who passed away in early 1992. Birch had served as President of the Geological Society of America in 1964, and was recipient of the Day and Penrose medals from GSA and the Bowie medal from AGU.

Much of **Dave Rea's** year has been devoted to planning and being co-chief scientist of Ocean Drilling Program Leg 145 which spent two months drilling in the North Pacific Ocean. The cruise, which left Yokohama in July and returned to Victoria in September, was devoted to collecting sediments that contain the Cenozoic geologic history of oceanic circulation and Northern Hemisphere sub-polar climate. Shipboard results give a vision of a much more dynamic history of Pacific ocean circulation than had been thought previously. Dave was accompanied by **Bob Owen** and graduate student **Hilde Snoeckx**, both of whom participated in the cruise as sedimentologists. Just before sailing on the North Pacific cruise, Dave finished most of his chores as an editor of a monograph on his second most favorite ocean entitled *The Indian Ocean: A synthesis of results from the Ocean Drilling Program* which will be published by the American Geophysical Union in late 1992.

The ocean drilling cruise interrupted **Hilde Snoeckx's** work on the Quaternary paleoceanography of the eastern Equatorial Pacific which will continue now that she is back in Ann Arbor. **Steve Hovan** is nearing completion of his PhD thesis on the paleoclimatic record provided by the deposition eolian dust in the deep sea. Steve gave both an invited talk and a poster presentation on his thesis subject to the Fourth International Congress on Paleoceanography held in Germany in mid September. Graduate student **Dave Dobson** is awash in data from our Great Lakes paleoclimatology project, conducted with **Ted Moore** as co-PI, and is in the throes of deciding exactly what to write up for his MS research paper.

Hello from **Larry Ruff** and other members of the Seismological Laboratory. Many things have happened over the past year or so. **Bart Tichelaar** and Naz left Ann Arbor for a European experience. Bart accepted a position at Shell Research Labs in Den Haag, The Netherlands. When last heard from, Bart was doing

"field work" in southern France. **Roland** and Martha **LaForge** returned to Colorado to resume their Golden lifestyle! Current members of the Seismo Lab are: **Jean Johnson**, **Nazli Nomanbhoy**, **Yuichiro Tanioka**, **Bob Thorson**, and **Leonid Zimakov**—in addition to faculty **Kenji Satake** and **Larry Ruff**. Everyone gets along quite well, which is important since the Seismo Lab and Geodynamics group have been compressed into a small temporary lab this summer due to construction. The geophysics labs, plus a few other labs in the department, were renovated as part of a NSF-UM sponsored effort. Yes, the ol' Seismo Lab received quite a facelift, and it appears that they even managed to fix the roof! The J.T. Wilson Library now has a more "distinguished" atmosphere. We are moving back into our spacious quarters this fall. On the research front, several students are working with **Kenji Satake** on tsunamis around the world. Kenji was part of an international team that went to Nicaragua to record the tsunami run-up heights after the recent large earthquake there. Leonid, who is from the Institute of Physics in Moscow, is working on statistical tests of various hypotheses of earthquake triggering—this is an interesting research direction. Yuichiro has become our "real-time seismology" expert by taking advantage of the rapid access to global seismographic stations through the IRIS data center. He can produce a preliminary earthquake study based on waveform inversion in a day or so after a large event! Other research interests include an on-going effort to understand earthquakes via the rupture process. On a sad historical note, the once-proud Anna, Ohio seismic network is no longer operating as of October, 1992. Seismic monitoring of the eastern USA will be done by the new generation USN stations. Ann Arbor will be the site of one of the few borehole stations of the USN, we will use the old deep borehole next to the WWSSN site. Speaking of the WWSSN station, we are reviving the old station to produce digital recordings of the long period instruments. To end on a personal note, Melissa and I now have two children as Nicholas was born this summer. We are all having a good time!

Ben van der Pluijm and his wife Lies Quint certainly had an eventful summer with the arrival of their second son, Robert, in early September; all are doing fine. The preceding summer months were used to continue the efforts on a structural geology textbook, "Micro, Meso, Macro—An Introduction to Deformation and Tectonics," and to prepare for a new introductory-level course, "How the Earth Works." Only two short field visits to students were made. One to **Alfredo Leon** who examines cratonic deformation patterns in western Newfoundland



(see photo, showing the gentle folds that mark the Appalachian Front), and to **Jay Busch** who unravels a part of the orogenic structure of the eastern Grenville in Ontario. A visit with **Bernie Housen** in the North Cascades, who works on magnetic fabrics in granites, was canceled because of Robert's impending arrival. Other students, **Nei-Che Ho**, **Steve Potts** and **Mark Rathmell** cheerfully continue their research on Appalachian paleogeography, mica fabrics and Grenville thermometry, respectively. Much of the real work in the Structure Group is actually carried out by undergraduate assistants **Don Cederquist** and **Joe McCaw**. This spring, **Margo Liss** completed her M.Sc. thesis on the paleogeography of a volcanic suite in northern New Brunswick. Post-doctoral fellow **Carl Richter** continues his research on magnetic fabrics in deformed rocks, which includes participation in an upcoming ODP leg (in fact, he will relieve **Bernie Housen** who is on the preceding ODP cruise). This year we welcome two new students: **Sean Todaro** in the northern Appalachian program (with **Rob Van der Voo**) and **Jim Cureton** in Grenville studies (with **Eric Essene** and **Alex Halliday**). A much-needed sabbatical lies ahead during which Ben hopes to complete his book as well as have uninterrupted time for hands-on research (the dreamer).

The past academic year was a hectic time for **Rob Van der Voo**, with Chair's duties, drafting figures for his book on paleomagnetism and tectonics (Cambridge University Press, early 1993), teaching, and guiding five graduate students (**Joe Meert**, **Steve Potts**, **Sean Todaro**, **Zhongmin Wang**, and **Weixin Xu**) in the paleomagnetic laboratory. This Fall, Dr. **John Stamatakos** arrived (PhD from Lehigh, postdoc at ETH-Zurich, Switzerland) and he will run the laboratory in the coming years. The summer, however, was quiet, so that a flurry of papers

could be prepared for publication. With **Don Peacor**, Rob and his students **Zhongmin** and **Weixin** are making a lot of progress in their project to document with electron microscopy techniques what the carriers of magnetization look like in a variety of carbonate and igneous rocks. A successful correlation between the presence or absence of hydrothermal alteration features in Permian basalts from China (as observed by SEM/STEM) and magnetic directions in these basalts has solved a longstanding riddle about the primary or secondary nature of some Permian paleopoles for South China. For a variety of carbonate rocks, the work of **Dongwoo Suk** (PhD '91, now at the University of Utah), Zhongmin and Weixin, is also beginning to clarify the secondary nature of magnetites, although the carriers of "primary(?)" magnetizations in these rocks are still unclear. The work of **Joe Meert** on the Precambrian of East Africa and North America and of **Steve Potts** and beginning student **Sean Todaro** in the northern Appalachians is also continuing to produce interesting results.

Torsten Vennemann's work with graduate student **Rodrigo Vasquez** and **Prof. Steve Kesler** revealed significant oxygen and carbon isotope halos around high-temperature carbonate hosted Ag-Pb-Zn mineralization in the El Mochito mine, Honduras. These halos may provide useful for exploration of these irregularly spaced ore-bodies. He continued stable isotope and fluid inclusion work on Late Archean to Early Proterozoic conglomerates of the Huronian and Witwatersrand Supergroups to place critical constraints on sediment provenance and attempt to resolve the importance of sedimentological versus hydrothermal control on Au and U mineralization. The first set of experimental hydrogen isotope fractionation factors between hydrous silicates and molecular hydrogen has been completed and suggests significant exchange at temperatures as low as 300°C. Experiments will ultimately be extrapolated to low-temperature calibrations of hydrogen isotope fractionation factors between hydrous silicates and water.

Lynn Walter and her research associates spent considerable time in the field conducting hydrogeochemical research over the summer. **Anna Martini**, **Jim Richards**, and **Vicky Hover** obtained well-head samples for detailed chemical and isotopic analyses from various oil and gas productive intervals in the Michigan Basin (Antrim Shale, Berea and PDC sandstones). These are currently very active plays in the

basin, and local oil and gas companies have been most interested and supportive of the project. **Ruth Blake** spent the summer at Chevron Research Lab in La Habra evaluating geochemical modeling codes and learning more about Angola Basin hydrogeochemistry/diagenesis.

Tim Lyons, Steve Bischof, Bob Klein, Vicky Hover (dive master!), and undergraduate research associate **Ron Dixon** spent 31 grueling days aboard the R.V. *Calanus* exploring modern carbonate sediment geochemistry on Great and Little Bahama Banks last July and August. An added thrill was missing by about six days the hurricane that smashed south Florida. Chemical analyses of the Bahama samples and data interpretation are getting a great assist from

undergraduate research associate **Sheila Murphy**.

Youxue Zhang's first year here was a busy one. He found that life of an assistant professor is much more complicated than that of a student or postdoc. There are so many things to be done in lab set-up, teaching and advising, research, and other departmental business. He struggled through the first year and managed to get a proposal for a multi-anvil press that can go to 200 kb (600 km deep inside Earth) funded by NSF. Despite the overload, he enjoyed Ann Arbor, the University, and especially the stimulating and friendly colleagues in the Department.

Memorial to Charles D. Campbell

by Joseph W. Mills

Charles D. Campbell, Emeritus Professor of Geology and long-time teacher at Washington State University, Pullman, Washington, died December 10, 1988, at his home in Carmel, California, after a lengthy illness. Death was attributed to heart failure. He was 83 years old.

Charles Campbell was born November 12, 1905, at Ann Arbor, Michigan. He was the son of Jennie Ives Campbell and Edward D. Campbell, professor of chemistry, University of Michigan. Following high school, Charles attended the University of Michigan, from which he graduated (B.S. with high distinction) in 1930 and earned an M.S. degree in geology in 1931. He earned his Ph.D. at Stanford University in 1934, specializing in petrology and mineralogy. His excellent academic and research record resulted in his election to Phi Beta Kappa, Phi Kappa Phi, and Sigma Xi. Proficiency in his chosen field was supplemented by developing a reading knowledge of French, German, Spanish, and Russian, and a speaking proficiency in French and German.

While attending Stanford University, he met Dorothy Jones, who was pursuing graduate studies at Mills College. They were married in Hayward, California, in 1938. Following Charles' retirement, they moved to California in 1975. Since his death, Dorothy has moved to Tucson, Arizona.

Charles Campbell was a Fellow of the Geological Society of America and the Mineralogical Society of America, and a member of the American Geophysical Union, the Geochemical Society, the American Geological Institute, the Northwest Scientific Association, and the National Association of Geology Teachers, for which he served as vice-president, 1959-1960, and president, 1960-1961.

Incipient tuberculosis plagued Charles from the time he was 18 years old, but it was kept under control by medication. However, he experienced enormous fatigue throughout his life. Additional health problems evolved after he moved to Carmel, California, in 1975. Despite such problems, which were rarely apparent to others, he never lost his sense of humor and wit. He led a happy life and died as gently as he lived.

The Department of Geology, Washington State University, is establishing a Charles D. Campbell Endowment fund, supported by present and former faculty, students, staff, and friends who enjoyed and benefited from their association with him.

In Memoriam

Robert M. Rigg (MS '37) died November 10, 1987. His widow states that he always spoke favorably of his time at the University of Michigan.

Helen Denning, wife of Professor Reynolds M. Denning (U-M Mineralogy Faculty, 1953-1968) passed away Sunday, September 28, 1992.

William G. Melton died on December 25, 1991. He was 68. William Melton was the preparator of vertebrate paleontology under Claude W. Hibbard from March 1957 to August 1966 and worked with him for many summers in Meade, Kansas. His research included Paleozoic ray-finned fish, conodonts and conodont-bearing animals, and soft anatomy classification. He was the author of numerous publications on Mississippian conodonts and fish fossils from Montana.

William C. Forcey (BS '38) passed away September 3, 1991.

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Degrees Granted

BS

Erik A. Gurshaw

MS

Sharon Feldstein, "Isotope and chemical microsampling: constraints on the history of an S-type rhyolite magma, San Vincenzo, Tuscany, Italy"

PhD

Antonio Arribas, Jr., "Geology and geochemistry of the Rodalquilar gold-alunite deposit; relationship to other hydrothermal ore deposits in southeastern Spain"

Arthur Leibold, "Sedimentological and geochemical constraints on Niagara/Salina deposition, Michigan Basin"

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