GEOSCIENCE NEWS

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

February 2002

Greetings from the Chair

An advantage of remaining at one University for most, if not all of a faculty career is having the opportunity to establish and sustain life-long friendships with alumni who visit and support your department's efforts. Long after the excitement of a particular research finding or class project has dimmed, it is the interactions with the students you worked with on research and taught in classes that remains vivid in the faculty experience. When I changed institutions two and one-half years ago I didn't fully appreciated how important alumni were to me. At Dartmouth I had looked forward to campus visits from familiar alumni and to the variety of off-campus events that provided opportunities for recounting old memories and seeking advice from people in the "real world." When I first arrived at Michigan, the faculty and current students welcomed me warmly – but visiting alumni were here to see their old friends and share memories – not to see the new guy in town.

This is perhaps why the Alumni Getaway at Camp Davis this past summer meant so much to me. The group of young and old-families and individuals-quickly bonded into a coherent group of what seemed like old friends – even though most had never previously met. Camp Davis and the natural beauty of the region provided a unique and almost magical atmosphere. However, it was their experience at the University of Michigan that everyone in the group had in common. For some, attending Camp Davis as students had been a life-changing experience that they wished to share with spouses and children. For others, the Alumni Camp was a chance to experience Camp Davis for the first time, having missed the opportunity during their student years.

For my family and me the Alumni Getaway provided the opportunity to develop what I expect will be lasting relationships with a group of alumni who care deeply about the department and the University of Michigan. For some of the alumni there are no longer any active faculty who were in the department when they were students, and the younger faculty they met at Camp Davis this past summer now provide their closest link with the department. By spending a week together, we have established our own set of common memories and experiences, which has made visits from "Getaway" alumni this past fall a special delight.

Everyone in attendance last summer seemed to have a special love for Camp Davis that was either rekindled or established for the first time. Whether it was the beauty of Cream Puff at sunset, the grandeur of the Tetons on a misty day, or the camaraderie of a bunch of former geology students gathered around a campfire – there was something about the experience that reached the soul of each of us. The group of about 30 participants represented a range of classes from '46 to '86. The participants and the activities are described in more detail in the following article. An unexpected and gratifying outcome of the event was an alumni initiative to form "the friends of Camp Davis" with the mission of helping the department maintain and improve the facility for the benefit of future generations of students. Thank you for your support and appreciation of Camp Davis. I look forward to your future visits to the Department or to sharing a future Alumni Camp experience with you.

Sincerely,

Joel D. Blum

Joel D. Blum
Chair

Camp Davis Alumni Getaway – 2001

This past summer, the Department celebrated its first annual *Camp Davis Alumni Getaway,* a week of alumni and family activities following the departure of students from Camp Davis. During the week of 12-17 August, over 30 alumni, family and friends participated in the event. Former students who had attended GS 440 as far back as the 1940's including Ken Keenmon (BS' 46, MS' 48, PhD '50), Mary Erickson (BS '52), Jack Barnes (BS '51, MS '53), Al Lange (BS '60), Ed Karp (BS '61), Ed Heck (BS '57, MA '65, PhD '68), Dave Sharp (BS '71, MS '72), Dave Struthers (BS '53, MS '57), and Cynthia Rossetti (MS '74). In addition to these alumni, 22 family members and friends shared the Camp Davis experience. The Department was represented by: Joel Blum, Kacey Lohmann, Andrea Dutton, Peter van Keken and Collen Currie. The group was also treated by a short visit by the Dean of LS&A, Shirley Newman, who took this opportunity to observe the unique qualities of Camp Davis first hand. Notably, we also had a good showing of the HELL CAMP 1986 Alumni who celebrated their 15th year reunion. This group, which included Ann Fitzpatrick (BS '86), John "Tex" Ferritto, Dave McCabe, and Kevin MacKay, has changed considerably since their initial days at Camp Davis, now toting along a caravan of kids and strollers, and armed with elaborate stories centered around events related to traveling across country with a young children. All have changed from those pre-employment years as students to responsible adults and parents who now serve as leaders in environmental firms and government agencies. Despite the passage of so many years since Hell Camp, this group still possesses remnants of its youthful and contagious energy, carrying the campfire activities into the early morning hours.This year's activities kicked off with a group float trip down the Snake River, not a rough whitewater ride, but a scenic reminder of years past as the Grand Teton came into and then passed from view. The course of the Snake River, twisting through the valley and surrounded by wilderness complete with moose, beaver, and eagles, renewed memories of the special times shared by everyone at Camp Davis. For a few alumni, this was their first visit. Having missed the chance to experience Camp first hand as a student, they acquainted

Ann Fitzgerald and Cindy Blum take a short break during their trek up Garnet Canyon.

High on the trail approaching Middle Teton Glacier, Ann Fitzgerald, Colleen Currie and Ben Herman (left to right) take a short break for a breathtaking view of Garnet Canyon in the background.

Scattered amongst boulder field in the upper reaches of Garnet Canyon, several alumni take a short breather by the stream after the long hike up the trail.

The traditional group picture of the alumni and staff during the 2001 Camp Davis Alumni Getaway.

The Next
Camp Davis Alumni Geology Camp
August 12 – 17, 2002

For those who want to ensure that they are able to get reservations for the plush faculty cabins, we urge to you contact Ann Titus (atitus@umich.edu) to make your reservations early. Arrive during the afternoon of 12 August and depart during the morning of 17 August. This next year's activities will include the highlights of last year's camp and include a variety of new fieldtrips, evening lectures and activities. A detailed schedule of events and reservation form with costs will be mailed shortly and will also be available on the Department's webpage: (http://www.geo.lsa.umich.edu).

themselves with the rustic setting of tin cabins, cold nights, and the rarified air of the Hoback Basin. The later Whitewater Trip became a highlight for many of the group, with rafts careening down the Snake River Canyon through standing waves that drenched even those who chose to cluster in the center of each boat. The rest of week provided activities for every desire. Those with a love of hiking made the long, uphill climb into Garnet Canyon on a clear and brilliant day. The day included vistas of Jackson Hole, a climb through boulder fields in Garnet Canyon, and periodic rest stops along the rushing stream of summer snowmelt which began high above in the canyon. Everyone made it as far as the Bowl. Those who retain their youthful endurance and competitiveness continued upward through the switchbacks and waterfalls, approaching the saddle below the Grand Teton. This hike, intended to be the first of many , satisfied the hiking spirit for most, with longer, more rigorous hikes giving way to more gentle activities of socializing and evening wildlife expeditions. One of the most spectacular evening trips was the Wildlife Safari guided by the Teton Science School. In a four hour adventure into the plains surrounding the Snake River in the shadow of the Gros Ventre Mountains, everyone was treated with spectacular views of moose and wildlife that appear during the few hours before sunset. The traditional Cream Puff climb came to fruition for only a few of the visiting alumni, who rediscovered why the mountain gained its name. Only one of our participants made it all the way to the top. Ben Herman, an athletic youth, was accompanied to the top by Kacey Lohmann, one of our aging faculty, who lagged behind but managed to make the summit.
The week's activities also provided an opportunity for learning more about the geology of the Jackson Hole region, with a full day field trip that started in the Snake River Plain volcanic flows and worked its way up through the structurally deformed sequences exposed in the Thrust Belt. In addition, evening lectures by both Joel Blum and Kacey Lohmann provided moments reminiscent of everyone's past days in the classroom. Given the great success of this last year's events, the Department has decided to continue this Alumni Geology Camp this summer. We hope that you will find this opportunity irresistible and join us next summer for a week of activities and refreshed memories.

Environmental Geology at Camp Davis

The 2001 field season saw the beginning of a new course at Camp Davis. GS 441: A Field Course in Environmental Geology was a great success, with 17 students enrolled. The class was spearheaded by Becky Lange and Charlie DeWolf (MS'89, PhD'93), who works as an environmental consultant with TriHydro Corporation in Wyoming, and team-taught by faculty members Joel Blum, Tom Baumiller, Peter van Keken. The course was designed to be an appropriate field experience for concentrators in the Environmental Geology, as well as for students in related fields such as School of Natural Resources and the Environment (SNRE) and the new LS&A Program in the Environment. This year's class included several students from other departments. Field projects were tailored to develop skills specifically related to the study of surficial processes and/or to environmental careers. This year's field projects included groundwater hydrogeology of contaminated sites in Jackson, surface hydrology of the Hoback River, a geophysics exercise to estimate the extent of the alluvial aquifer in the Bryan Flats valley, and a surficial geology mapping project in the Pinedale area.

Unique to this course is its emphasis on case studies in current environmental issues. Despite its scenic location, it turns out that Camp Davis is an exceptional location for such studies. The Idaho National Energy and the Environment Laboratory (INEEL) is only three hours away in Idaho Falls. Wyoming has a resource-based economy and is currently in the midst of a large boom in natural gas development. With tourism the other major industry in the area, anything environmental is a high profile and public issue.

During the first part of the course, students toured project sites in topic areas including natural resource development, aquifer protection, nuclear waste storage and disposal, petroleum remediation, and mine reclamation, and had the opportunity to speak with professional geologists involved in the projects. Students also participated in chemical and hydrogeological characterization of petroleum release sites currently undergoing groundwater cleanup in Jackson.

These experiences would not have been possible without help, in the form of access and donation of equipment and personnel time, from the following companies, agencies and organizations whom we wish to thank:

The City of Laramie Environmental Advisory Committee

The Coalbed Methane Coordination Coalition

The US DOE-Idaho National Energy and Environment Laboratory (INEEL)

Geotech Environmental Equipment, Inc.

Pine Environmental Services Inc.

Texaco

TriHydro Corporation

URS Corporation

The Wyoming Department of Environmental Quality

New Well for Field Camp

A looming crisis in the water supply for Camp Davis this lead to the drilling of a 140 foot deep well during the summer of 2001. The existing water system is a naturally flowing spring from a perched aquifer in the Cretaceous Bear River Formation situated above the Eardley Cabin. Consisting of three slotted pipes driven into the hillside, this spring has survived decades of use and has faithfully supplied the water needs for Camp — although stories persist about those years when group showering was recommended to conserve water. Last year the rate of water flow began to decrease in response to a particularly dry season in western Wyoming. The University contracted a local firm, Jackson Drilling, to find and drill for water.

The firm's owner, a 'water-witcher' of local fame, sited the well using a freshly cut willow branch that vibrated violently as he traversed the area near the entrance to Camp. Despite his years of experience in drilling for water and the recent drilling of two wells on the adjacent property, he encountered an unexpected stratigraphic section. He anticipated up to 90 feet of gravels, Quaternary-aged alluvial deposits, but these were much thinner with only 45 feet occurring at the Camp Davis site. The majority of the well penetrated black shales, siltstones and thin sandstones of the Cretaceous Bear River Formation, which includes a 6 foot thick horizon of light gray, cohesive clay that we have interpreted as bentonite, an altered volcanic ash layer. We were surprised when at a depth of 90 feet in carbonate-cemented sandstones we were pumping about 50 gpm and at 115 feet in siltstones and fine sands the pumping rate increased to about 150 gpm. We interpret the high pump rate to reflect the fractured nature of the Bear River Formation. at this location, on one limb of the Willow Creek anticline. After two days of drilling, the well was completed at a total depth of 140 feet, cased and tested. Apparently, after prolonged pumping the well is still delivering water with a small amount of suspended clays, likely sourced from the horizon of bentonite. Hopefully by the 2002 field season, this well will be fully functional.

This event of well drilling at Camp provided a unique opportunity for some of the students and staff who logged and sampled the well. **Emily Johnson** (BS'2002) and **Peter van Keken** logged the first 60 feet of the drilling; **Kacey Lohmann** and **Jan Kappmeyer** (MS' 82) finished the sampling and well descriptions to produce the stratigraphic section accompanying this article.

Kacey Lohmann (left) and Jan Kappmeyer (right) describing the well cuttings and constructing the stratigraphic section of the Camp Davis 2001 water well.

Drilling of the new water well at Camp Davis was undertaken by a local company, Jackson Drilling at the entrance to Camp in full view of Cream Puff.

Progress on the Origin of Whales

by Philip D. Gingerich
University of Michigan

Whales are often in the news, and I think this is because we somehow see ourselves in them. We see the mystery of our intelligence in the mystery of their intelligence. We see the mystery of our origin in the mystery of theirs. And whales are literally 'extraterrestrials,' having moved from land to sea, which heightens their interest too. The most recent news about whales stems from a discovery we made last year in Pakistan. This was published in *Science* where it was featured on the cover (Fig. 1). We were able to report a long-sought breakthrough in understanding the origin of whales.

We see the mystery of our intelligence in the mystery of their intelligence

There are some eighteen major groups or 'orders' of mammals living today. One of these is Primates, including lemurs, monkeys, apes, and us. Another is Artiodactyla, including the even-toed or split-hoofed plant-eaters like cows, deer, hippopotami, etc. A third is Cetacea, including all of the great whales and the smaller dolphins and porpoises. Surprisingly, few of the eighteen orders can be traced back to any common ancestry in the fossil record. We know they are related, but our theories of genealogy depend more on inference than on direct fossil evidence.

Figure 1. Reconstruction of Rodhocetus *from the early middle Eocene showing the hoofs it retained on the middle digits of the hand, and its long, delicate webbed feet. Body proportions suggest that it lived much like sea lions do today, feeding in the sea but still coming onto land to breed and give birth. Painting is by John Klausmeyer of the U-M Exhibit Museum.*

Inference of horizontal 'sister' relationships of living animals is the stock in trade of molecular biologists specializing in phylogeny. Paleontology, in contrast, is a much more historical science and we are primarily interested in vertical ancestry and descent through time. When fossils are missing we have to admit that we just do not yet know how a group originated. Molecular biologists have become insistent in recent years that whales are most closely related to plant-eating artiodactyls and to hippos in particular. Paleontologists have generally accepted a distant relationship to artiodactyls, but have drawn the connection through a group of extinct Paleocene-Eocene meat-eating mammals called mesonychids.

When proponents of different methods cannot agree, everyone suffers, because there is no way to know who is

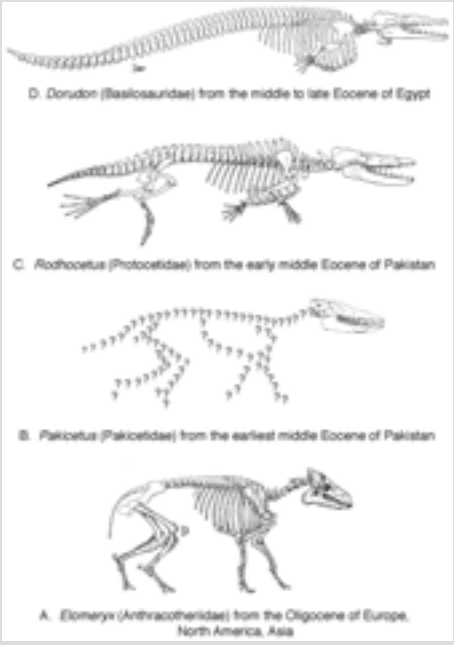

Figure 2. Four stages in the evolution of whales from even-toed artiodactyls. A, early land-dwelling anthracotheriids ('coal beasts') are now thought to be close to the origin of both whales and hippos. B, pakicetids are a critical stage in the transition from land to sea but lack associated skeletons. C, protocetids are now, as of 2001, known from complete skeletons showing that their ankle was artiodactyl-like, while the foot as a whole shows they were predominantly aquatic. D, basilosaurids such as Dorudon *are known from complete skeletons from Egypt showing that they were fully aquatic and could not have supported their weight on land.* Dorudon *was the subject of a 1996 Ph.D. dissertation in Geological Sciences by Mark Uhen. Animals shown here range from two to five meters in body length. Drawings are adapted from Scott, 1894; Gingerich, 1983; Gingerich et al., 2001; and Gingerich and Uhen, 1996). Undergraduate Doug Boyer drew the skeletal reconstruction of* Rodhocetus.

right and who is wrong. Mesonychids are extinct and cannot be analyzed by molecular genetic methods, so the only way to test whether whales are related to artiodactyls through mesonychids or through hippos is to find fossils tracing whales back in time. This is more easily postulated than done, as I can illustrate by summarizing where we stand after some 25 years spent tracing the early evolution of whales.

What I outline here is based on twenty U-M fossil-collecting expeditions to Pakistan and Egypt. These have involved many U-M students over the years, and international experience for students has always been part of their rationale. The Egyptian interlude was dictated by the Soviet invasion of Afghanistan, which made field work in the tribal areas of Pakistan impossible. As of this writing, war in Afghanistan has again delayed our field work.

Whales or Cetacea are marine mammals that look and live like fish. Whales differ of course in being warm-blooded and nursing their young like we do. A whale's body is virtually all head and tail, separated by a short neck and thorax. The front limbs are modified into flippers extending from the sides of the body. The hind limbs have completely vanished externally. Whale tails are muscular and have a broad, horizontal 'fluke' at the end. This is the hydrofoil that propels a whale as it is forced up and down through the water. Fish are similar, but propel themselves by side-to-side movements of a vertical tail. Neither moves like a land mammal!

There are two kinds of whales living today: toothed whales and baleen whales. Both can be traced from the present back to the Oligocene, when modern patterns of ocean circulation, heat transport, and upwelling were established. Whales from the Eocene belong to a third group of ancestral Archaeoceti or archaic whales, which are both older and more primitive in numerous ways. It is useful to recognize three progressively older and more primitive stages within Archaeoceti: Basilosauridae, Protocetidae, and Pakicetidae (Fig. 2).

The first archaeocete was described from North America in 1834, when it was thought to be a giant marine reptile and named *Basilosaurus* ('king lizard'). Backbones of *Basilosaurus* are shaped like thick foot-long logs and pretty much all look the same. This modularity had great potential, and in the 1840s the German showman Albert

Koch exhibited a 114-foot version called '*Hydrargos sillimanii*' on Broadway and elsewhere for a 25¢ admission fee. Koch's *Basilosaurus* was named for Benjamin Silliman, Yale's then widely known professor of chemistry and natural history, and founder of the venerable *American Journal of Science*. This gave *Hydrargos* some temporary scientific respectability, but the number of backbones and the true length of the skeleton were not known until the 1980s when we found and mapped dozens of good *Basilosaurus* skeletons in the Western Desert of Egypt. None were complete, but careful construction of a composite indicated that *Basilosaurus* had 66-68 backbones in a skeleton totaling 'only' 18 m or 58-60 ft in length. To our astonishment, we also found that *Basilosaurus* and its close relative *Dorudon* (Fig. 2D) retained functional hind limbs with feet and toes, which raised the possibility that older archaeocetes might retain distinctive ankle bones enabling us to tell whether they evolved from mesonychids or from hippo-like artiodactyls.

Once we found and documented good skeletons of basilosaurids, the next challenge was to understand protocetids. These are primitive in retaining a backbone with a bony connection to the pelvis and hind limbs, meaning that they could still support their weight on land. Our Pakistan field work in the 1990s focused on protocetids, and yielded many skulls and partial skeletons representing a surprising diversity of forms. The new skeletons were frustrating though because all were missing their fore- and hind limbs and most of the tail, which seem to have been removed by scavengers before burial. There is just no substitute for finding limbs and tails together with skulls and backbones, and in 1999 I realized that we had to search for whales in different environments if we were going to find hands and feet.

Thus in 2000 we concentrated field work in a new area on the west side of the Sulaiman Range, in the highlands of eastern Balochistan. We moved here expecting that paleogeographically we would be farther off the Indo-Pakistan subcontinent and farther out in Tethys, finding fewer whales in deeper water, and hoping that these would be less disturbed by scavengers. Only one of these expectations turned out to be true, but it was the one that really mattered! We are now working in shallower water closer to shore (its own tectonic and paleogeographic mystery), but we are finding whales at the same rate and these are virtually undisturbed by scavengers.

To our astonishment, we also found that* Basilosaurus *and its close relative* Dorudon *retained functional hind limbs with feet and toes

Figure 3. Photo comparison of ankle bones of the primitive protocetids Rodhocetus *(left) and* Artiocetus *(right) with those of a modern pronghorn (center). The* Rodhocetus *and pronghorn ankles are from the right foot, while that of* Artiocetus *is from the left foot. Note the 'double-pulley' structure of the astragalus bone (arrows) connecting the foot to the lower leg, and the notched cuboid (asterisk) below the astragalus, which together are diagnostic of artiodactyls.*

The first of the whales found in 2000 was located our first morning in the field when graduate student Iyad Zalmout called me to look at bone fragments weathering out on the surface. Geological Survey of Pakistan [GSP] geologist Munir ul-Haq and I joined him. Iyad gave me a grooved piece of bone he had already recognized as the body of a left astragalus, a critical ankle bone for testing how closely whales are related to artiodactyls. At the same time Munir picked up another that I thought was the similarly-grooved body of the right astragalus. I worried for five minutes about why the symmetry seemed distorted, and then realized that, miraculously, the two pieces fit together to make a single complete astragalus. It was grooved on both ends because it was a 'double-pulley' astragalus characteristic of artiodactyls (Fig. 3). Excavation revealed much of the rest of the skeleton, including the best protocetid skull ever found. This belonged to a new whale that we named *Artiocetus* to emphasize the resemblance of its ankle to that of artiodactyls. The most complete hands and feet were found later and belonged to a different whale called *Rodhocetus* (Fig. 2C).

The most primitive group of archaic whales is Pakicetidae named for the earliest middle Eocene whale, *Pakicetus* (Fig. 2B), that we found in Pakistan in the 1970s. There are not as yet any associated skeletons of Pakicetidae, so it is impossible to know how aquatic *Pakicetus* may have been. A study by J. G. M. Thewissen and others published in *Nature* recently claimed that *Pakicetus* was a terrestrial runner, based on isolated bones found in a quarry where pakicetid and land mammal bones are mixed together– circumstances unlikely to convince many skeptics. The oldest pakicetid, *Himalayacetus*, was found in marine strata, so it is hard to understand how *Pakicetus* could have been terrestrial. Such an interpretation also contradicts aquatic features of the ears and skull bones in the original specimen of *Pakicetus* that first indicated a relationship to whales.

Why is what we found in 2000 so important? The skeletons we found are paleontological 'Rosetta stones' in the sense that each combines clear evidence of whales with clear evidence of artiodactyls *preserved in the very same skeleton*. These skeletons resemble archaic whales because they have the distinctive skulls and teeth of archaeocetes, and they resemble artiodactyls because they have the distinctive ankle structure of artiodactyls. The evolutionary line connecting whales and artiodactyls did not go through carnivorous mesonychids. Further, the hand and foot bones

of *Rodhocetus* resemble anthracothere or 'coal-beast' artiodactyls in particular (Fig. 2A). Anthracotheres are the group of artiodactyls that hippos are thought to have been derived from, which suddenly makes a 'sister' relationship of whales and hippos plausible. Thus it appears that our molecular colleagues were right all along and the fossil record is now saying the same thing. Whales are derived from artiodactyls, and we can move on to focus on when and where and how whales became aquatic, and how herbivorous anthracotheres became carnivorous whales. Finding an articulated skeleton of a pakicetid would be a good place to start.

What does it take to carry out a successful expedition in Pakistan? There are five co-authors on our 2001 *Science* report: me, Munir, Iyad, Intizar Hussain Khan, and M. Sadiq Malkani. We were the scientists in the field making the discoveries, but there were a lot more people involved before the *Science* report came out. A proposal to work where we did was developed with the advice of the Director General, Mr. S. Hasan Gauhar, and three Directors at GSP headquarters in Quetta, Messrs. Abdul Latif Khan, S. Ghazanfar Abbas, and Dr. Imran Khan. Balochistan is virtually all tribal, and foreigners must be cleared by national and provincial security bureaus. On the road and in the field we five geologists moved with three drivers, three cooks, and at least one 'levi' guard in each car, making a field party of fourteen or more. Help for supplying the camp with water or excavating whales was always hired locally. Security is a big concern and camping involved finding suitable walled enclosures surrounding schools, medical dispensaries, or government rest houses where cars, equipment, and people could be protected at night.

Fossil skeletons were removed from the field in 40-50 kg blocks of rock tightly bandaged in burlap and plaster. These were shipped by air to Michigan, where William Sanders and undergraduate assistant Joseph Groenke in the Museum of Paleontology opened the bandaged specimens and prepared them for study.

Figure 4. Tea in the field with drivers and guards at the end of a successful day! Graduate student Iyad Zalmout is standing; GSP geologist Munir ul-Haq, who spent winter term 2001 in Ann Arbor, is in the cap at left; and Muhammad Arif, who spent the summer of 2000 here is second from right.

We are greatly indebted to William Sanders for making the most of fossils that did not always look like much when they were collected. Technical illustrations for the Science paper were prepared by Museum artist Bonnie Miljour and by undergraduate Doug Boyer. The Science cover illustration was prepared by John Klausmeyer, and casts for exhibition were prepared by Dan Erickson of the of the U-M Exhibit Museum. When you add eight manuscript reviewers, the work became a collective effort of some three dozen collaborators! Thanks too to the National Geographic Society and the National Science Foundation for providing field and laboratory funds making this collaboration possible.

Faster Employment and Greater Job Satisfaction: PhDs in Earth and Space Sciences

The overwhelming majority found work within the Earth and space sciences

Recent graduates in the earth and space sciences are finding satisfying employment faster, and at higher pay in most sectors, than in previous years, according to a new report from the American Geophysical Union (AGU), American Geological Institute (AGI), and the American Institute of Physics (AIP).

For the third year in a row, new graduates with doctoral degrees in the geophysical sciences are spending less time looking for work. In 2000, the average time spent was only 3.4 months, compared with 5.5 months in 1998 and 4.7 months in 1999. The overwhelming majority found work within the Earth and space sciences and almost all of them in science or engineering jobs.

AGU and AGI have collected data about new PhD graduates for five years, from surveys of the graduates themselves. Some additional data came from the National Science Foundation. Only graduates of American universities who have remained in the U.S. are included in the study.

The continuing upward trend is reflected in recent graduates' perception of the job market. In 1996, only 4 percent described it as good or excellent, while 65 percent described it as hopeless or bad. In 2000, 28 percent described the job market as good or excellent, and just 22 percent said it was hopeless or bad. Partly, this reflects the shorter time required to find a job and partly the higher starting salaries now offered.

About half of the new graduates moved directly into permanent full time positions, while 42 percent took temporary postdoctoral jobs, usually at universities. The remainder took other temporary jobs. More than half of all respondents are engaged primarily in research.

"The Earth and space sciences produce more female PhDs than most physical sciences," noted Jennifer Giesler of AGU, an author of the study. "Only the life sciences and chemistry produced more," she said, "and their employment characteristics are virtually identical to that of men. With regard to gender issues, no news is good news."

But, not all graduates found work in the science they had studied, noted Megan Henly of AIP. "In 2000, there was an overproduction of PhDs in ocean sciences," she observed. "While most reported finding satisfying employment, half of the new ocean scientists found work in other fields."

Nicholas Claudy of AGI pointed out that new PhD's in the solid earth sciences tend to be older than their counterparts in other physical sciences. "There is no readily apparent explanation for this," he said. "The master's is the degree of choice for nearly all non-research employment, so possibly these scientists worked in industry for some years before returning to universities for doctoral programs."

Whether they were working in industry, academe, or government, recent graduates had many positive comments, including the intellectual challenge of conducting one's own research (25 percent listed it as the most rewarding aspect), the opportunity for continued learning (19 percent), or teaching and working with students (13 percent). Comments about their jobs included, "a dream come true," "doing what I enjoy," and "I enjoy it 24/7."

The happy employment experience of the 2000 graduates may reflect their experience in graduate school. Only one in ten reported that they had considered dropping out of the Ph.D. program regularly or constantly, compared with 50 percent in 1996.

The report, "Earth & Space Science PhDs, Class of 2000," was written by Jennifer Gielser (AGU), Megan Henly (AIP), and Nicholas Claudy (AGI). It may be read in full on the AGU and AGI web sites at http://www.agu.org/sci_soc/careers.html (scroll to "Survey of Recent PhD Graduates," then click on "Class of 2000") or http://www.agiweb.org/career/phdreport00.pdf.

The Earth and space sciences produce more female PhDs than most physical sciences

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Alumni News

Rev. David W. Plumer (BA'54) spent the fourth of July visiting the longest covered bridge in the world. This 1282 foot-long, one hundred years old structure is located in Hartland, New Brunswick, Canada. David spent the last two weeks of August 2001 in Bangor, Boston, St.Paul, Minneapolis, and Hibbing to visit his son Marshall and family at Crane Lake, Minnesota. Marshall is a Ranger in Voyageur National Park (Southern Canadian Shield). He tends the lakes, land, and islands at the Canadian border. David noted that the book "Noah's Flood" is really fascinating and certainly quite plausible, even from a theological point of view.

Leo J. Lammers (MS'56). has recently moved from Roswell, New Mexico to the mountains above Ruidoso and is semi-retired.

David A. Rochna (BS'58). After forty years David has recently retired from the Coastal Oil and Gas Corporation. He now devotes his time to traveling, spoiling his grand children and pursuing hobbies. He offers thanks to the many colleagues that have made his career most enjoyable.

Leigh W. Mintz (BS'61, MS'62) retired from California State University, Hayward, on July 1, 2001 as Associate Vice President of Curriculum and Academic Programs and Professor of Geological Sciences after thirty-five years at the university. He spent twenty-nine years in the administrative position. Leigh has moved from the San Francisco Bay area to the Sierra Nevada foothills for retirement.

Darwin Spearing in the late 1950s

Darwin R. Spearing (MA'64, PhD'69) continues as a National Park Service (NPS) Interpreter at the Rocky Mountain and Joshua Tree National Parks. Reception by the NPS to Dar as a geologist has been great – there are not many geologists on staff in NPS! Dar has been happy working with and impressed by Geocorps geologists in the parks (an association of Geological Society of America and NPS). There are more opportunities for geologists in this venue. Geologic research in parks has been elevated immensely with Congress' 1998 Omnibus Parks Act, which fosters research in National Parks.

Norman W. TenBrink (BS'65) is about to start his twenty-ninth year in the Grand Valley State University Geology Department – time flies! There are now twelve PhD faculty, plus staff, which is quite a change from the four faculty department he joined in 1973. Shirley and Norman made the move to a condo this summer and love it! They now have more time to spend together, and at their cottage on Hamlin Lake, near Ludington. Finally, two more geologists are in the family. Norman's son Andy and his wife Robin will both finish their geology PhDs in the spring of 2002.

Roger L. Gilbertson (PhD'72) has spent five years in Santa Cruz,

Bolivia, with BHP Petroleum. On July 13, 2001, Roger passed his 25 year anniversary with BHP Petroleum. Roger continues to maintain contact with **George McIntosh** (PhD'83) and **Brad Macurda** (U-M Faculty '63-'78).

For the last two years, **Anne Blount Sanford** (BS'72, MS'78) has been the Supervisor of the Physical Anthropology Casting Lab at the Cleveland Museum of Natural History. Anne and her volunteers mold and cast primate bones, mostly skulls, for university and museum teaching collections. It's a perfect part-time job for a mom with two teenagers. Anne spends her days in the company of some truly gifted eccentric scientists, but she's home when her boys get home from school. They are now creating a new complete cast of "Lucy", the 3.2 million year old hominid from Ethiopia, in order to do a computer simulation of her gait. The job occasionally involves a bit of teaching as well as when two community college students came to her recently with the question, "Who is older, Lucy or Eve?"

The Michigan-New York economic geology contingent consisting of **Karr McCurdy** (BS'81) who is with Citibank and **Dave Stenger** (MS'97) who works for Lehman Brothers, both escaped harm in the September 11 attacks, although Dave's office building was severely damaged.

Jeff Huspeni (MS'82) has been busy this year helping with mergers to pull his company *Newmont* up to #1 in gold production world-wide. He says, "I was busy with project reviews and due diligence leading up to this transaction, but by no means was it a one man show. It took a lot of quality effort from all three companies and staff. I'm excited at the opportunities it provides…". Jeff continues to serve on the Department's Alumni Advisory Board.

Jeff Huspeni around 1979

Albert "A.J." Birkbeck (BS'83, MBA'85). After sixteen years in Chicago, Albert and his family moved back to Michigan this summer. While he enjoyed working for BP Amoco and practicing environmental law in Chicago, they are glad to be back. Albert will continue practicing environmental law at his old firm, Fulcrum Law Group, which now has offices in Michigan, Illinois, and Colorado. His focus will remain on innovative approaches to large and complex clean-ups.

Sonja Pettingill (MS'89) is currently teaching sustainable business/ environment courses as an Adjunct Professor at Ursinus College in Collegeville, Pennsylvania. She is also doing distance learning consulting for industry and educational institutes. Sonja just got married, has moved and is dealing with renovations, but life is terrific!

Ed Van Hees (PhD'00) has joined the Geology Department at Wayne State University and is already taking students on field trips to Canada. Welcome back to Michigan Ed!

Merril Haas Remembered

A life-long interest in oil seeps led Merrill Haas, ’32, to a career in oil exploration with Humble Oil Refining, later known as Exxon. In its Explorer tribute to Haas, the American Association of Petroleum Geologists (AAPG) hailed Haas as a “leader in his profession, his industry and his association for more than six decades.”

A native of Albert, Kansas, Haas had boyhood dreams of becoming a dance band piano player. But after working with some young friends to create a topographic map of Shawnee County, Kansas, Haas focused his educational goals and his eventual career on geology. His studies brought him to the University of Kansas and later to the University of Michigan where he studied with A.J. Eardley and developed a fascination with oil seeps.

Haas got his first geology job in August of 1933 as a micropaleontologist with Humble Oil Company for a monthly salary of $150. He soon was transferred to Venezuela, where he met his wife Maria Lara. They married in 1944 and had two sons and two daughters. In 1950, he became chief geologist for Carter Oil Co., in Tulsa. There he advanced as exploration manager (1953), director and exploration manager (1956) and vice president and director (1957). In 1960, he was named vice president of exploration for Exxon USA. Promoted through the ranks, he eventually ended up in Houston by way of New York and Tulsa. In 1975 he retired from Exxon as vice president of exploration and went into private consulting.

In his professional life, Haas assumed numerous leadership roles. He served as AAPG president in 1974-75, an AAPG Foundation Trustee in 1976-89, and chairman of the AAPG Foundation in 1989. In 1986, AAPG awarded Haas its highest honor – the Sidney Powers Memorial Medal. Merrill passed away on April 21, 2001.

In Memoriam

John R. Hultman (BS'51, MS'53) passed away on January 2, 2001. He began his career in Roswell, New Mexico, followed by moves to Billings, Denver, Durango, Anchorage, Houston, and finally Stavanger, Norway. He retired in 1985 after thirty-two years of devoted service with Conoco Oil Company., moved back to Roswell, and spent fifteen years in happy retirement. He is survived by his wife, Ann.

Cramon Stanton (BS'40) passed away on August 10, 2001. Cramon was the President of Cramon Stanton, Incorporated of Houston, Texas. He is survived by his wife, two sons and one daughter.

Lloyd W. Staples (MS'30) died September 19, 2001. While at the University of Michigan, Lloyd studied the Molybdenite ore from Climax and received his MS in 1930. He subsequently received his PhD from Stanford University and served as a Professor at the University of Oregon, Eugene. He is survived by his wife, Phoebe, and their three children.

Honors, Awards, Kudos

Jeff has fundamentally changed the direction of "big science"

Jeffrey Alt has won U-M's Research Scientist Achievement Award. Jeff, who joined the U-M Geological Sciences faculty in 1989, has fundamentally changed the direction of "big science" expeditions involving the ocean depths. He is a seasoned hand at sea, having sailed on eight two-month cruises of the Deep-Sea Ocean Drilling Program and served as co-chief scientist on one. He also has studied ancient hydrothermal systems on the island of Cyprus and recently used remotely-operated vehicles to sample hot water vents and volcanic rock beneath Yellowstone Lake in Wyoming. His discoveries regarding the interaction between seawater and ocean crust have ramifications for such important research topics as the organic carbon budget, cycling of elements through the ocean, the study of ecosystems that may be found on other planets and the origin of life on Earth.

Katie Davis, a current PhD student in geophysics, received an Outstanding Student Paper Award from the Tectonophysics Section of the AGU, for her poster paper "In-Situ Raman Spectroscopy of the SiO2-H2O System at Elevated Temperature and Pressure. Her work is supervised by **Lars Stixrude** and **Carolina Lithgow-Bertelloni**.

Eric Essene, Phil Gingerich and Rob Van der Voo have been awarded Collegiate Professorships by the College of LS&A. Each honoree has the privilege of choosing the name to be attached to the Professorship. **Eric** has chosen to be the William C. Kelly Professor of Geological Sciences; **Phil** as the Ermine Cowles Case Collegiate Professor of Paleontology, and **Rob** the Frank H. T. Rhodes Professor of Geological Sciences. **Phil** has also been elected to the American Academy of Arts and Sciences.

This solid can be used to immobilize plutonium from dismantled nuclear weapons

The Office of Science at the U.S. Department of Energy recently published its list of the 101 most important discoveries it has supported during the past 25 years, and the list included work by **Rod Ewing**, Professor of Nuclear Engineering and Radiological Sciences, Professor of Materials Science and Engineering, and Professor of Geological Sciences. Rod's research group has discovered a material, Gd-zirconate, that is highly resistant to radiation damage. Present studies indicate that ten weight percent plutonium can be incorporated into the structure and that this phase will remain crystalline for at least 30 million years. This chemically durable solid can be used for the immobilization of Pu from dismantled nuclear weapons.

Carolina Lithgow-Bertelloni has been the recipient of two prestigious research fellowships that honor young faculty. The first, the David and Lucile Packard Fellowship in Science and Engineering, is awarded to encourage promising young faculty to pursue research on virtually any topic they wish, unfettered by the usual bureaucratic requirements of proposals and frequent reports. The fellowship carries an award of $625,000 spread over five years. Carolina's research focuses on how

convection in Earth's mantle interacts with the surface, creating uplift and subsidence, evidence for which can be observed in landscape evolution, the sedimentary record and climatic history. The Packard Fellowship is awarded to only twenty-four persons nationwide, and the candidates are nominated by the presidents of their universities. Carolina was also one of six U-M faculty to be awarded a Sloan Research Fellowship, which also focuses on supporting young researchers. The award is for $40,000 over two years. Fellows are free to pursue whatever research interests them, and to use the funds to support their research with very few restrictions.

Carolina was one of six U-M faculty to be awarded a Sloan Research Fellowship

Jane Ginopolis, the Department's key administrator, received the Exceptional Service Award from the Vice-President for Research in the Fall of 2001.

Marie Tharp (MA'45) has been honored by the Lamont-Doherty Earth Observatory of Columbia University with a Heritage Award for her artistic renditions of ocean floor topography. These maps, now universally appearing in earth science textbooks and also published by the National Geographic Society, revealed the submarine world of mid-ocean ridges, transform faults, abyssal plains, seamount chains, and much much more. The citation for the award reads (in part) as follows:

"Determined, ingenious and visionary, Marie Tharp is a quintessential scientific pioneer. She has trod where none else had before, simultaneously blazing two trails into unexplored territories. As a scientist, she revealed for the first time the previously hidden and unknown seafloor and provided the first maps to guide earth scientists in this new realm. As a woman, she also charted the course, opening up the field of earth science to women and providing a role model for women scientists …. For scientists and lay people alike, [her] maps revolutionized our understanding of our planet almost as dramatically as Copernicus did centuries before."

Marie Tharp's maps revolutionized the understanding of our planet

Photo: Bruce Gilbert, Lamont-Doherty Earth Observatory

In correspondence with **Helen Foster** (BS'41, MS'43, PhD'46), a classmate at U-M in the 1940s, Marie writes "I'm very thankful for the background that my geology and mapping experiences at U-M's Camp Davis gave me for my work years later mapping the world ocean floor."

James Lee Wilson (U-M Faculty '78-'85) of New Braunfels, Texas, has been named winner of the 2002 Sidney Powers Medal of the AAPG. Jim is Professor Emeritus at the University of Michigan and Adjunct Professor at Rice University, where he also was a chaired professor. He also has taught at the University of Texas at Austin, University of Houston, University of California at Berkeley, University of Calgary and the Rosenstiel Institute for Marine Sciences. Jim's career includes about 15 years with Shell and Royal Dutch Shell as an exploration and production research geologist. He is also known for his book *Carbonate Facies in Geologic History*, which has been translated into at least six languages. His AAPG accomplishments include being named the AAPG Distinguished Educator awardee in 1995. Jim will be honored at the AAPG annual meeting to be held March 10-13 in Houston.

Decorating C. C. Little

The **Halls and Walls Committee** consisting of **Dale Austin, Chris Claflin, Kate Griffin, Steve Kesler, Tracy Kolb, Ted Moore,** and **Bill Wilcox** has been working for the last year on ways to improve the appearance of Department public spaces. During the late summer, their first efforts were mounted, including an 18-foot long polished slab engraved with GEOLOGICAL SCIENCES in the main entry foyer and a 4 by 6-foot polished slab of metamorphosed conglomerate on the second floor. The conglomerate contains rounded cobbles of felsic and mafic intrusive rocks along with quartzite and other metamorphic rocks and has been pervasively altered to epidote and chlorite providing something for almost everyone! These are only the first of many polished slabs that will be added to halls during the coming year. Additionally, photographs of field work, geological maps of some of the more spectacular regions of the world, and badly needed building directory signs are being added to each floor.

Undergraduate Exit Interviews

There was uniform agreement that field trips and field courses provided extremely important learning experiences

Each year, the Department of Geological Sciences conducts exit interviews for graduating seniors to find out where they are going and what they think can be done to improve the undergraduate experience. Three of our respondents had summer intern positions, one with the USGS, another with the Smithsonian Museum, and the last with the U.S. Park Service. Three had full-time jobs, one with a consulting firm and two with oil-service companies, and four were planning to go to graduate school, with one each to SMU, University of California, U-M and Davis. As might be expected, opinions about classes varied greatly, but there was uniform agreement that field trips and field courses provided extremely important learning experiences. Five of the graduating seniors carried out research projects during their stay at Michigan and all agreed that this was also a valuable experience. The Geology Club was singled out for comment by several students, all of whom appreciated its efforts to get undergraduates involved in the life of the Department.

Faculty, Staff and Student News

Joel Blum is pleased to report that he has graduated his first two U-M students — **Stephen Peters** (PhD'01) and **Andy Jacobson** (PhD'01) and thus has now officially helped add to our list of illustrious alumni. Steve was awarded an NSF postdoctoral fellowship and Andy is working on a postdoctoral project with Joel. Both are remaining at the U-M for at least another year to pursue new postdoctoral research projects. In other news from Joel's research group, geochemist **Bjorn Klaue** was recently appointed a research scientist, geochemist **Andrea Klaue** was appointed a senior research associate, and ecologist **Brian Kennedy** joined the group as a postdoctoral fellow to pursue research at the boundaries between ecology and geology. Ongoing research projects for the group include: studies of the petrology and environmental geochemistry of As, Hg and Pb; the forest and soil biogeochemistry of geologically-derived nutrients; the application of new geochemical tracers to hydrogeology; and the use of isotopic tracers to study animal movements.

Students working with **Eric Essene** have made notable advancements in the last year. **Carl Henderson** (graduate studies, '82-83, currently lab manager of the EMAL) received a University staff award for his outstanding contributions to the success of the lab. **Zach Sharp** (PhD'90) just obtained tenure at the University of New Mexico. **Meg Streepey** (PhD'01) is taking a post as Assistant Professor at Florida State University. **Ed Van Hees** (PhD'00) has just started teaching at Wayne State University. **Liping Wang** (PhD'99) continues his high pressure experiments as a Postdoctoral Fellow at Stony Brook University. **Donggao Zhao** (PhD'98) has been in charge of an electron microprobe laboratory at the University of South Carolina for about a year now.

Dan Core, a PhD student, who is working on some remarkable oxidized granites with **Steve Kesler** and Eric Essene, presented a talk on anhydrite-bearing granites at the fall GSA meeting in Boston. **Casey Donohue** (PhD'02) presented experimental studies on Zr and Ti substitutions with Craig Manning (UCLA) and Eric at the GSA meeting. **Zeb Page**, another PhD student, is working with **Sam Mukasa** and Eric on eclogites of North Carolina; he gave a talk on some of that research at GSA. **Eric Tohver** (PhD student) is studying the thermobarometry, structure, chronology, petrology and paleomagnetism of Proterozoic rocks in Brazil. Both Erics traveled to Brazil this summer to see Grenville equivalents in Rondonia. The trip was very interesting for its cultural and culinary experiences as well as geological sights.

Eric taught Mineralogy 231 this fall and also ran the Bancroft pegmatite trip. The students are doing mini-projects on some of the rock-forming minerals that were collected on the trip — Silver Crater and other locales. The weather was quite cold and wet, but everyone liked the trip anyway.

Carl Henderson (EMAL Lab Manager) and Eric spent far too much time evaluating electron microprobes after being funded by NSF and various units at U-M for a new microprobe. They ordered a CAMECA SX-100 in February and have just completed its installation. The new probe is a welcomed addition, although it is sad to give up Carl's software system on the old Camebax.

Finally, Eric is very pleased to report that his spouse **Joyce Budai** (PhD'84) has taken a job as a senior program officer at the Great Lakes Colleges Association (GLCA) in Ann Arbor. The GLCA provides program training for a consortium of small colleges in the Michigan, Ohio, and Indiana tri-state area, comprising Albion, Antioch, DePauw, Dennison, Earlham, Hope, Kalamazoo, Kenyon, Oberlin, Ohio Wesleyan, Wabash and Wooster Colleges. She is working very hard and is facing new challenges as the only scientist in her group. Her current e-mail address is budai@glca.org.

Since we last heard from him, many of **Dan Fisher's** thoughts have been on the far north. Late this past summer, he and graduate student **Mark Nabong** traveled to the Taimyr Peninsula, the northernmost extension of continental Siberia. They spent most of their five-week stay in the village of Khatanga, working in and just outside of a "lednic", or ice-cave (-15 degrees C), cut into the permafrost. This cave now houses one of the largest collections of mammoth tusks in the world, amassed over the past two years by the concerted efforts of the "Mammuthus Project", an international consortium for the study of late-Pleistocene faunas of

northern Eurasia. Dan's and Mark's objective was to measure the most well preserved of the tusks and collect core-samples for later analysis from a subset of them. The purpose of this, in turn, was to investigate several aspects of the paleobiology and health status of woolly mammoths, well before the time of their extinction. The tusks were magnificent, and the work went smoothly, if slowly, except when the local electrical system failed. However, the combination of a portable generator and frequent task-switching kept things moving forward.

Dan and Mark lived well on black tea, dry bread, raw fish, onions, and lots of reindeer/caribou (none with red noses, to their knowledge). Highlights of the trip included several extended forays onto the tundra to collect additional specimens. Dropped by helicopter onto a surreal landscape of patterned-ground, solifluction slopes, and low-gradient rivers, cloaked with lichens, moss, and a host of wildflowers and cotton-grass, and inhabited by lemmings, polar foxes, seasonal birds, caribou, reintroduced muskoxen, and occasional wolves, they covered many tens of kilometers prospecting for late Pleistocene fauna emerging from the thawing permafrost. Contacts with colleagues working under difficult conditions in the former Soviet Union reminded them of how fortunate we are to be able to depend on laboratories, offices, and generally stable working environments. As the daily cycle of the sun finally began to dip below the horizon, Dan and Mark pried themselves away to return "down south." Customs difficulties greatly complicated return of their samples, but most of the tusk-cores are now back in Ann Arbor, and the rest should be here by the time this reaches you.. Other projects retain their hold on portions of Dan's time, but it sounds like the lure of the north is likely to draw him that way again.

Steve Kesler attended the Hydrothermal Odyssey Meeting at James Cook University in Townsville, Australia where he gave an invited lecture on the geochemistry of gold in porphyry copper systems. He also visited Normandy's Pajingo gold mine, which is an unusual epithermal system of Paleozoic age that formed within a hundred meters of the original surface but has been preserved from erosion by an unusual sequence of geologic events….a geologic situation similar to that Steve has outlined for the newly discovered Jacinto epithermal vein system in Cuba. In August, Steve attended the Gordon Conference on Inorganic Geochemistry with **Dan Core** (PhD expected 2003) where he chaired a session and Dan presented a poster. In October, Steve took part in the National Underground Science Laboratory conference at the Homestake Mine in Lead, South Dakota. With Homestake about to close the mine, there is widespread interest in the scientific community in putting it to use as an underground laboratory for experiments and tests, particularly in physics and geology.

Becky Lange continues her field studies of the volcanic arc in western Mexico and her lab-based studies on the physical properties of magmatic liquids. Graduate students **Holli Frey** and **Kate Kenedi** spent November and December, 2001 in Mexico, presenting papers at the Mexican AGU meeting in Puerto Vallarata and then continuing their field studies in western Mexico. Becky joined them for two weeks of field work. The project in Mexico involves collaboration with **Hugo Delgado-Grenados** from UNAM and **Chris Hall ,** our expert in Ar geochronology from U-M. A new post-doc, **Yuhui Ai**, joined Becky's research group in December, 2001. His expertise is in acoustics and he will be working on measuring sound speeds in silicate melts to derive their compressibility. Graduate student **Qiong Liu** is continuing her experimental studies on the density of hydrous silicate melts and will be working closely with Dr. Ai. Undergraduate **Emily Johnson** is working with Becky this year on a project to constrain the timing of volcanic eruptions linked to the recent uplift along the eastern escarpment of the Sierra Nevada. This work involves collaboration with **Pat Cashman** at the University of Nevada, Reno. Becky continues as undergraduate advisor (with **Phil Meyers**) and is now the Director of Camp Davis. She is also kept busy with editorial duties with the AGU monograph series, as Treasurer of the Geochemical Society, and served this year on the Mineralogical Society of America Medal and the AGU Bowen Medal committees.

This last year has been full of exciting new adventures for **Carolina Lithgow-Bertelloni**. Having received two fellowships in support of new research ventures since October 2000, she has been able to expand the scope and size of her research group. Continuing to actively pursue her interests in mantle geodynamics, Carolina has now been able to add active research programs in lithospheric deformation and fault interaction, and in the relationship between tectonic uplift and long-term climate variations. Specifically, in the last year Carolina

has had the fortune to convince three very talented scientists to join her in these areas of intellectual pursuit: **Sue Bilek** from University of California, Santa Cruz, **Clint Conrad** from Massachusetts Institute of Technology and **Meg Streepey** from U-M. Meg has now joined the faculty at Florida State University, but we hope to continue our collaboration on the mechanisms of post-orogenic collapse and fault interactions. Her results suggesting that extension in the Grenville province of North-America is the result of both changes in plate driving forces and an impinging plume have already garnered considerable attention at the GSA in Boston this year.

Clint and Carolina are actively working on models of plate driving forces, particularly including the very important resisting effect of plate bending at subduction zones. Clint showed in his thesis work that plate bending could be a very dominant resisting force at subduction zone, perhaps completely altering our view of what drives plate tectonics. He presented his results at the fall 2001 AGU meeting. Sue joined us in September of 2001, and while continuing to pursue her seismological calling, looking at changes in the properties of subduction zones with **Larry Ruff**, we will soon start looking in detail at the possibility of stress-triggering of earthquakes, by doing some in-depth modeling of faults in close proximity. A new student, **Xu Xiqiao**, has also joined us this fall, and we plan to start looking at the effects of transform faults on plate rearrangements. **Jerome Guynn** and **Mark Wenzel** have had an exciting year as well. Mark visited a fluid dynamical lab at Berkeley this summer, where he did experiments on dispersal of particles in particle-laden fluids. Jerome attended a workshop in Aussois and will be attending fall AGU, to present his results on the mantle contribution to the stress field of the lithosphere. Finally, Carolina has recently taken over the role of Turner Seminar Series czarina, and is enjoying it greatly. We have a very exciting speaker slate for this academic year, and she hopes to continue to satisfy faculty and student requests, while expanding the intellectual horizons of the department. (see http://www.geo.lsa.umich.edu/announce/turner02.html for Turner lecture information)

Bob Owen is now in the first year of his second term as Associate Dean for Undergraduate Education in the College of LSA. Although this position is very time consuming, Bob and his research group continue to pursue a number of paleographic investigations. Recently **Casey Hermoyian** received the Outstanding Student Presentation Award from the American Geophysical Union for her paper on "The Late Miocene-Early Pliocene Biogenic Bloom: A Worldwide (and Possibly Pulsed) Event." **Peter Knoop** is currently participating as a shipboard scientist aboard Ocean Drilling Program Leg 199 in the equatorial Pacific, which is focused in part on reconstructing movement of the inter-tropical convergence zone during the Cenozoic. **Tina Johnson** and postdoctoral researcher **Jamie Gleason** also plan to work on samples recovered from Leg 199 by employing new techniques for developing improved age-depth profiles in red clay cores by using ichthyolith strontium isotope stratigraphy.

Rob Van der Voo attended an international conference (International Association of Geomagnetism and Aeronomy) in Hanoi, Vietnam this past Summer. It was a surprisingly pleasant and interesting experience, characterized by meeting many gracious local people, an exquisite cuisine, a beautiful countryside and, last but not least, a mind-boggling traffic pattern of (mostly) motorcycles. Rob gave talks on his recent research on non-dipole contributions to the ancient paleomagnetic field and on electron-microscopy results obtained by former graduate student **Weiming Zhou** (PhD'00) and current graduate student **Daming Wang**, who is now in his third year of work on the magnetic properties of ocean-floor basalts supervised by Rob and **Don Peacor**. Weiming now does research related to modern communication tools for Motorola in Chicago. **Arlo Weil** has completed his PhD investigating late Paleozoic deformation in Cantabria, Spain. He started a tenure-track faculty position this past fall at Bryn Mawr College in Pennsylvania, continuing his Precambrian paleomagnetic work on rocks from the Uinta Mountains and the Grand Canyon in collaboration with **John Wm. Geissman** (PhD'80 and adjunct faculty at U-M). Adam Collins participated in his second lengthy field season this past Summer, collecting paleomagnetic samples in Kazakhstan, in a collaborative project with **Dr. Misha Bazhenov** (Visiting Scientist, 2002) of the Geological Institute of the Russian Academy of Sciences. The aim is to unravel the displaced-terrane histories of island-arc components amalgamated into the Kazakhstan block. **Maodu Yan**, working with Rob and **David Rea, Josep Parés** and **Xiao-Min Fang** from Lanzhou University (Visiting Scientist, 1996, 2001), studies the Neogene

deposits of western and central China with magnetostratigraphic and sediment-analytical techniques. With **Trond Torsvik** (Visiting Scientist, 1995) of the Norwegian Geological Survey, Rob continues to explore (and modify) the assumption that the geomagnetic field was purely that of a dipole. This non-dipole field may cause errors of up to 8 degrees in the determination of paleomagnetic pole positions, which some people have suspected all along. **Jingwei Si** completed his MS thesis and is now in the graduate program at George Mason University in Virginia. He had been testing the occurrence of a Quaternary reversal, called the Blake Event, in Chinese loess and paleosol sequences. Having found no evidence for the Blake, he completed for his thesis a non-dipole explanation for the anomalously low paleolatitudes in Tertiary rocks from Central Asia. Working with **Ben van der Pluijm** and Rob, **Eric Tohver** has been investigating the paleomagnetism of 1200 Ma rocks from western Brazil, which suggests a new and improved pre-Rodinia configuration of Laurentia and Amazonia that makes a lot of sense.

Recently Granted Degrees

Undergraduate

Baird, Erin Jennifer	Oceanography Marine Geology and Geochemistry
Wagner, Curtis Vincent	Earth Sciences
Huebner, Sonja	Earth Sciences

Masters

Borges, Melroy R. ..... *A New Calibration of the Garnet-Clinopyroxene Thermometer and Barometer*

Clafin, Christopher L. ..... *Thermobarometry of the Peshtigo Monzonite, Wolf River Batholith, Wisconsin, USA*

Odegaard, Carrie ..... *Stratigraphy of the mid-Holocene blank bands in Lakes Michigan and Huron: Evidence for possible basin-wide anoxia*

Page, Frederick L. ..... *Prograde and Retrograde History of Eclogites from the Bakersville Area, N.C.*

Palenik, Christopher S. ..... *Radiation Damage Accumulation in a Zoned Zircon Crystal*

Peters, Stephen C. ..... *The Origins and Geochemical Behavior of Arsenic in a Fractured Bedrock Aquifer, New Hampshire*

Si, Jingwei ..... *Tow-low Magnetic Inclinations in Central Asia: An Indication of a Long-term Tertiary Non-dipole Field*

Doctorate

Solum, John G. ..... *Mineralogy and Microfabric of the Punchbowl Fault, an Exhumed Member of the San Andreas Fault System*

Zalmout, Iyad S. A. ..... *Postcranial Skeletons of Protosiren From Egypt and Pakistan and Their Bearing on Locomotion in Early Sirenia (Mammalia)*

Zhou, Pinbo ..... *Origin of the Dufek Layered Mafic Intrusion and the Ferrar Igneous Province, Antarctica: A Geochemical Approach*

Jacobson, Andrew Darin ..... *Silicate versus carbonate weathering in the Himalaya Mountains and the New Zealand Southern Alps*

Joseph, Leah Helen ..... *Late Cretaceous through Cenozoic climate change on Antarctica: A view from the deep sea*

Odegaard, Carrie ..... *Stratigraphy of the mid-Holocene blank bands in Lakes Michigan and Huron: Evidence for possible basin-wide anoxia*

Robinson, Rebecca Sprague ..... *Plio-Pleistocene nutrient dynamics and export productivity in the California and Benguela curren upwelling systems*

Steinle-Neumann, Gerd ..... *Physics of iron and Earth's inner core*