# GEOLOGY NEWS

Department of Geological Sciences ▲ University of Colorado at Boulder ▲ Spring 1997



# MESSAGE FROM THE CHAIR

*Gifford Miller*

As we ease through our final semester in the Old Geology Building and prepare to move into the Benson Earth Sciences Building, our new home across campus, there is a distinct feeling of change in the air. The heart of any department is its faculty, and in this respect we are in the midst of a transition period. Over the past decade, most of the faculty familiar to our old alums have decided its time to hang up the old rock hammer, and enjoy their senior years. With Pete Birkeland's retirement at the end of the current academic year, we realize that a transformation has occurred. The faculty who were the core of the Department through the sixties and seventies, names like Walker, Bradley, Eicher, Curtis, Braddock, Munoz, Larson, and Birkeland, are now retired. With their departure, we are recruiting the next generation of Earth scientists who will carry on the tradition of excellence established by an earlier generation. This year we are again recruiting for an Aqueous Geochemist, as we were unsuccessful in recruiting our top candidate last year. We anticipate recruiting at least one new faculty each year for the next several years. We seek to replace those faculty who have retired with the very best young talent in the country. And beginning next year, we will be able to carry on this tradition of excellence in a building better suited to our needs.

The Benson Earth Sciences Building looms large on the horizon, quite literally. As we go to press, construction has topped out, and we are very close to being fully closed in from the weather. The sandstone veneer is nearly complete and red tiles should be appearing on the roof any day. It has been exciting to watch the actual structure emerge and match with the design that we spent the last two years developing. The building promises to provide us with superb laboratory space, vastly improved teaching facilities (remember those annoying columns in the middle of rm 311, and office complexes that encourage interactions between faculty and students.

New teaching laboratories include a hydrology classroom fringed by sinks so that students can perform actual experiments, and a 1200 square foot computer teaching laboratory with a full complement of advanced computer platforms. The computer lab will allow faculty to utilize new 3-D visualization tools, range from the atomic structure of crystals to large-scale structural features and 3-D seismic stratigraphy. It will provide students with terminals for homework and thesis writing, and we are planning on providing two general-purpose high-end workstations for student use in the lab. Peripherals include a large-format plotter, slide maker and color printer for special projects, as well as the standard scanners, digitizers and laser printers for general student use. The undergraduate Geology Club has been busy deciding how to furnish their Study Lounge that we carved out of building space to help provide an improved environment for our majors. In addition to 100 lockers in the adjacent hallway, we provided the Club with funds to set up the lounge in the way they thought it would best serve their needs. The idea is to have a space that encourages informal group study sessions, provides internet access, and generally serves as a "home-away-from-home" for our majors.

In addition to watching our building take form, the Department has spent much of the last year preparing for, and moving through Program Review. This process, which all units go through every seven years, provides the Department with the opportunity to make its case for excellence to the Vice Chancellor. We completed our Self Study in October. In November we were evaluated by a three-member Internal Review Committee: Bernard Amadei (Civil Engineering), Bill O'Sullivan (Physics) and Ellen Zweibel (Astrophysics, Planetary and Atmospheric). The IRC provided a strong endorsement of the Department. Our external team, composed of Sue Kieffer (Geological Survey of Canada) and Don Turcotte (Cornell), visited campus in late January. Sue and Don spent two days on campus, meeting faculty, students and administrators. They came away from nonstop meetings with a pretty complete sense of the breadth of our program, and subsequently wrote a strong report endorsing many of our most important requests. We are grateful that colleagues of high national stature were willing to take time from very busy schedules to undertake the task of providing an external assessment of our program. We now await the final recommendations of the Program Review Panel, due in late April, to learn whether we succeed in capturing the imagination of the committee with the excitement and relevance of the Earth Sciences as we enter the 21st century.

With our Self Study and new Strategic Plan, we also developed a revised mission statement that I wanted to share with our alumni (see below). The statement attempts to recognize our central role in the education of Liberal Arts students, regardless of their eventual major, and at the same time clearly articulates our essential responsibility to advance knowledge about the whole Earth system through research and graduate education.

We are planning a reception in the new building after the Homecoming football game next fall (September 27), and a special ceremony dedicating the building in late October. Details are elsewhere in the Newsletter. Whether you can make the Dedication, the Homecoming Open House, or just want to stroll through the building, please stop by when you are next in town.

## Mission Statement

### Department of Geological Sciences, University of Colorado at Boulder

The Department of Geological Sciences, through excellence in teaching and research, advances understanding and appreciation of the Earth: its resources, structure, processes, and history. We work to create an informed and scientifically literate public, capable of making the choices required for a sustainable future, and we are dedicated to educating the next generation of leading Earth and planetary scientists. Through basic research, our faculty and students further understanding of the past, present, and future whole Earth system, including linkages between the solid Earth, and its enveloping hydrosphere, atmosphere, and biosphere.

## Is it done yet?

The new Benson Earth Sciences Building is growing by leaps and bounds, with the building's dedication slated for October of 1997. Here, Bill Braddock and Suzanne Larson check out the corner view. For photos of the progress made so far, please see pages 6 and 7.

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# Faculty News

## Bill Atkinson

Some good news on jobs in economic geology! People from several companies called Bill during the year, looking for new employees. Bill had a complex, productive year in 1996. There were the usual teaching duties that included teaching the field structural geology class for the first time. The class particularly enjoyed mapping underground for half the semester in the Clipper Mine, where they saw real, live faults and gold veins. A weekly evening ore deposits seminar was enlivened by alumnus Kevin Francis' presentation of 3-dimensional computer projections of mines he is working on. In the fall, Bill put a lot of effort into the giant intro geology class. An ore deposits class was more fun, with exercises in mine mapping, core logging, and trips to Central City, Bingham, Utah, and one snowy trip to Leadville.

Classes are only a part of Bill's teaching. A great deal of effort, both in the office and in the field, went into helping graduate students. John Gray finished his PhD thesis on mercury deposits of southern Alaska. Michele Murray and Paul Boni both reactivated their thesis writing, and Michele has completed a draft. Alex Iriondo spent months in the field, meeting Bill and one of his Spanish professors in his field area at Sonoyta, Sonora in April. Later, Alex worked on radiometric dating and light stable isotope analyses. Sara Martínez passed her prelims, worked as a TA, and did field work in the summer. She is working on variations in sericite in different types of ore deposits. Lupe Espinoza passed his prelims and comps and continued field work at Cerro de Oro, Sonora. Abbas Sharaky also passed his prelims, and started field work at Jamestown, Colo., on the relations between a porphyry moly system and epithermal veins. Armando Zaragoza returned to Mexico in January and was able to complete a first draft of his thesis on the structural caldera setting of some gold deposits in Chihuahua. Worth Cotton, a new MS student, has spent the last 3 years working in mines in Chile, and intends to do a thesis there.

Bill's teaching was not confined to CU. He was invited to present his three-day short course on the geochemistry of gold deposits to three groups in Latin America. The Department heard a one-hour condensed version of the course in our weekly colloquium in the fall. The first short course was held in March at the University of Sonora for a group of mostly industry geologists, with some students. In May, he gave the course to geologists of the Consejo de Recursos Minerales at a training facility near Guadalajara, then, in August, to industry and student geologists at the Universidad Técnica at Oruro, Bolivia. Bill's wife, Carol, accompanied him to Bolivia, where the University there prevailed on her to give a guest lecture on psychology.

Teaching in Latin America is interesting, but lecturing three days straight in Spanish for each course was challenging. Bill went to the Tintaya copper mine in Perú in July as a consultant, to help them with their core–logging system, but wound up spending half his time teaching classes to Peruvian geologists. The entire time in Perú and Bolivia was difficult, due to the 13,500 foot altitude of the altiplano. During the year, Bill even managed to spend some time on his own research, completing a manuscript on Los Pelambres, Chile, having spent two summers there. It appeared in a special volume on Chilean porphyry copper deposits. He also gave a talk at GSA on his work at Moctezuma, Sonora, and wrote grant proposals with his students to CONACYT (the Mexican NSF) and to NASA. His service activities include finishing 5 years on the Economic Geology editorial board, and arranging the Department's fall picnic and field trip. The picnic was a Mexican barbecue, where Bill and some of his students broiled mountains of meat, to be scarfed down with salsa, tortillas, tamales, salad, fruit, cookies, beer, pop, etc. As they say, "a good time was had by all."

## Roger Bilham

In 1996 Roger Bilham's crustal deformation group remeasured parts of the Nepal Himalaya using GPS and started the installation of a fixed GPS array designed to monitor positions to 3 mm precision continuously. Seven permanent sites were installed by Freddy Blume and Becky Bendick at locations selected by alumni Mike Jackson in 1991. Points in this array show the Himalaya to be squeezing at approximately 17 mm/year caused by the descent of India beneath Tibet at roughly 20 mm/year. The Greater Himalaya are rising at 3 mm/year at present, slightly slower than points to their immediate south. Some of these activities will be shown in an IMAX movie of Mt. Everest to be released in 1998.

Freddy Blume was successful in finding many of the original points that were used to measure the height of Mt. Everest in 1950-52 by the Survey of India. This required climbing some 20 miles vertically over a period of several months carrying a gravimeter and GPS receiver. He plans to develop a better geoid for the Himalaya and to estimate the amount of visco-elastic deformation that occurred after the Great Bihar/Nepal earthquake of 1934. Becky Bendick initiated a study of river profiles in the Himalaya in 1996 which entails dynamic GPS tracking of the river elevations while white water rafting. Knick points in river profiles cause white water sections of the Himalayan rivers, and represent active subsurface structures responsible for their deformation. We will be able to watch Becky hard at work in the Himalaya because her burdensome task was recorded by a Discovery Channel movie team.

## Peter Birkeland

Pete Birkeland took on some new teaching in the field modules (the introductory one and the surficial geology/geohydrology one, co-taught with Shemin Ge). Both of these were fun, as classroom time is minimal and Front Range geology is hard to beat. On the writing front, he is working on the 3rd edition of the soils book. Because there is no time to write papers, much of his recent research (soil development in NM and on the Pacific Ocean Islands) will be included in the book. He met former students Fred Hawkins and Larry Anderson up skiing, and they told him all of his former students will buy the book, assuring large royalty checks! In May he presented a short soils course in Barcelona to students and faculty involved with Jordi Corominas (here on sabbatical several years ago). He and Sue decided to remain in Spain to bike much of the Pyrenees from east to west. They reported great weather and biking (steep and hilly as they crossed the drainages), few people that early in the season, and that their Spanish served them well. In one town they ran into Joe and Cathy Frank, who had ridden up from Barcelona on a tandem. Joe was a graduate student of Erle Kauffman several years ago. The fall GSA meeting was in Denver, so Pete and former students Dan Miller, Penny Patterson, and Ralph Shroba ran a field trip to discuss soils and geomorphology of the Piedmont (see photo), starting at contact corner, made famous by the study of Ernie Wahlstrom, and ending at the Ralston Reservoir cut, first studied by Julie Brigham.

## Shemin Ge

Shemin's hydrogeology research group has welcomed two new members, postdoc Elizabeth Screaton (see photo in Tailings, page 15) and graduate student David Kinner. Liz received her PhD from Lehigh University in 1995. Her research is in the area of general hydrogeology with expertise in hydrology of the ocean margin environment. Shemin and Liz are working together on understanding some coupled processes involving subsurface fluid flow, heat transfer, and mass transport in actively deforming media such as accretionary prisms at converging plate margins. Their recent work involved examining the three-dimensional effects of the prism geometry on fluid migration patterns. They constructed a two-dimensional map-view representation of the Barbados Ridge decollement to numerically model fluid and heat transport. Flow patterns from the map-view model were used to construct cross-sectional flow and heat transport models along flow paths, allowing assessment of the sensitivity of heat flow at the toe of the prism to along-strike fluid migration. Initial modelling results suggest that the along-strike component of fluid flow is of the same order of magnitude as the cross-sectional component. They presented these results at the American Geophysical Union annual meeting in San Francisco in December. Liz headed to Barbados after the meeting and spent her Christmas at sea on the latest Ocean Drilling Program mission.

*The GSA fieldtrip crew (l to r): Al Price, government soil scientist, Pete Birkeland, Penny Patterson, and Ralph Shroba.*

David Kinner graduated from Amherst College in 1996 with a BS in geology. He has started a collaborative research project with Dr. Robert Stallard of USGS. He is interested in better understanding the relationship between the surface hydrology, subsurface hydrology, and soil chemistry of a watershed in Central America.

Shemin's ongoing research on rock fracture properties continues to progress well. Her theoretical work on the new governing equation describing flow in rough fractures appeared in the first 1997 issue of *Water Resources Research*. The new theory incorporated the concepts of true aperture and tortuosity, which are not reflected in the well–known Reynolds equation. Complementary to the theoretical development, graduate student Miles Waite conducted a series of laboratory experiments under the supervision of Professor Hartmut Spetzler. The experiments measure the permeability of fractures that have progressed from parallel plates to sinusoidal surfaces. In the meantime, Miles is working on a lattice gas automata model to understand the complex nature of fluid transport in irregular rock fractures. Miles presented a part of the research at the GSA meeting in October. After his talk, Miles was referred to at the meeting by other colleagues as the "sinusoidal guy."

Graduate student Jennifer Hinds is moving along with her research on perched water formation and capillary flow in unsaturated heterogeneous porous media. The major finding of this research is that faults may have played a major role in forming the observed perched water under Yucca Mountain, Nevada. She has accepted a position at Lawrence Berkeley National Laboratory of the University of California at Berkeley as a senior research associate. While settling in on the west coast, she will finish up the final writing of her thesis and present her work at the AGU Hydrology Days.

Other highlights of Shemin's research include surface water–ground water interaction which is the PhD dissertation topic of graduate student Gordon McCurry. Under the mentoring program, geology undergraduate Collin Craven has been participating in the research since the beginning of the fall semester. Collin has compiled a hydrological database and made water-level maps of the Boulder Creek watershed.

On the teaching front, Shemin's Introduction to Hydrogeology class continues to grow larger with students from nine majors across the campus. The field trip and computer lab exercise are always well received. She looks forward to the new building where the new computer facility will provide a whole new dimension for her class. She is also longing to set up a hydrogeology laboratory in the new building for the class. In the spring, she also ventured to offer an introductory-level geology class. It has proven to be quite an interesting and fruitful experience for her. In the summer, Pete and Shemin co-taught a new field course (see report on page 8).

## Bill Hay

Bill was in residence at CU during the spring semester, arriving from Europe for the start of classes after giving a lecture to the Austrian Geological Society in Salzburg on Cretaceous climate. He again taught the course "Introductory Oceanography" which continues to become more popular. He also taught a more advanced course "Oceanography," for seniors and graduate students, and "Paleoclimatology/Paleoceanography" for graduate students. He returned for brief visits to Europe twice in February, to give a lecture in the Symposium for the opening of GEOMAR's new building in Kiel, to teach a short course on Paleoclimatology in Utrecht for the Netherlands School of Sedimentary Geology, and to give the opening address at the meeting of the Geologische Vereinigung in Amsterdam. During early March he chaired the JOIDES Sedimentary Geochemistry and Processes Panel meeting at Scripps in La Jolla. Over spring vacation he attended the General Earth Research Model symposium in Lyon, France, and returned to France a few weeks later to attend the JOIDES Planning Committee Meeting in Aix-en-Provence. There, being naive, innocent, and knowing nothing about the subject, he was selected to chair a JOIDES Detailed Planning Group for ocean drilling in the Antarctic.

In June, Bill flew to Kiel, Germany, and spent the summer at GEOMAR. It was a cool, cloudy summer in Europe. He attended the SEPM Conference on Carbonates and the Global Carbon Cycle in Wildhaus, Switzerland, where the participants experienced snow in June. The first European meeting of the Oceanography Society in Amsterdam in July provided an excellent occasion to meet old friends. In July and August there was plenty of time to work on research at GEOMAR and complete papers for publication. September

and October were very busy, with the JOIDES Information Handling Panel meeting in Kiel. Recent PhD Rob DeConto came over, and they attended the 5th International Cretaceous Symposium in Freiberg, Saxony, where Bill gave an invited talk and Rob presented the initial results of a Cretaceous Ocean circulation simulation. Afterward, they took a brief vacation in Prague, staying in a pension run by friends Bill had known in the 1960s when he used to work at the Czech Academy of Sciences in the summer. Prague is a great place these days, perhaps the most interesting city in Europe, with an enormous number of concerts and theatrical performances. After a brief visit to Greifswald, where Bill would teach later in the fall, Rob returned to the U.S. Bill then presented the opening address at the IAMG conference "Computerized Modeling of Sedimentary Systems" in Gustrow, north of Berlin, dashed on to a Cretaceous working group conference in Goettingen, and from there to Oslo, to teach a short course with Chris Wold, organized by Saga Petroleum, arriving back in Hamburg just in time to chair the opening session of the Congress on Latin American Geology. Bill spent the fall semester as "Gastprofessor" at the Geological Institute of the Ernst-Moritz-Arndt University in Greifswald northeast of Berlin, near the Polish border, and at the Institute for Baltic Sea Research in Warnemuende, on the coast north of Rostock. Monday through Wednesday in Warnemuende and Thursday and Friday in Greifswald for lectures on Paleoclimatology became the routine, and Bill got to know the roads very well with the two- to three-hour drive between the two institutions. Greifswald and Warnemuende are in former East Germany, and it was very interesting to work with the students. Average attendance at the lectures was about 25, with students from geography and biology as well as geology. The East German students are remarkably well-trained in math, physics and chemistry, and most have already spent at least a month touring the US, a replacement for the annual field trips to Siberia of the old days.

This year Bill spent Christmas and New Years in Kiel, experiencing some of the coldest weather in Europe in years.

## Bruce Jakosky

NASA successfully launched the Mars Global Surveyor and the Mars Pathfinder spacecraft this fall. MGS will arrive in September and orbit the red planet, and MP will land on Mars on the 4th of July. Associate Professor Bruce Jakosky is an investigator on the MGS and has proposed to be involved in the MP mission. His focus will be-on using the data from the missions to understand the nature of the Martian seasonal cycles and the history of water, on all timescales from hours to billions of years.

In addition, Jakosky has been working with graduate student Kevin Hutchins to understand the history of water and other volatiles on Mars. They have been using ratios of isotopes of the light noble gases (argon and neon) and the climate-related species (carbon and oxygen, in particular) to describe the processes that play a role in the evolution of the climate. The approach is similar to that for analyzing of stable isotopes on the Earth, although there are some processes that operate on Mars that do not operate on Earth. Included in these is the loss of gas from the top of the atmosphere to space. This loss preferentially removes the lighter isotopes and leaves the atmosphere with a characteristic signature of enrichment of the heavier isotopes.

They have also used the stable isotope measurements to jump into the fray regarding possible life on Mars. Measurements of several properties of meteorites that are from Mars have been used by a group at NASA to suggest that there may be possible fossil life within these meteorites. Hutchins and Jakosky used the measurements of $^{18}O/^{16}O$ and $^{13}C/^{12}C$ to constrain the temperature at which the carbonate deposits within these rocks formed, and thereby whether life could have existed at that time. They found that the temperature must have been between about 40 and 250 degrees C, effectively straddling the temperature of 150 degrees C above which life could not exist.

The question of whether there is life on Mars is very closely tied to the earliest life on the Earth. Based on what we know about the origin of terrestrial life, there is every reason to expect that life could have originated independently on Mars. Whether we do or don't find life on Mars will have profound implications for our understanding of the origin of life on Earth.

## Craig Jones

### Beyond Plate Tectonics . . .

If you get tossed out of bed one night by an earthquake in California, you can be sure to be greeted by a morning paper or T.V. show replete with demonstrations of how the earthquake is tied into the sliding of the Pacific plate past North America. Should you be tossed out of bed in, say, Nevada or Utah or even Colorado, the explanations in the morning will be far more vague, appealing perhaps to mountain building. Understanding the causes of these earthquakes away from the plate boundary motivated a study by Research Asst. Prof. Craig Jones and his colleagues Dr. Jeffrey Unruh (Wm. Lettis and Associates) and Prof. Leslie Sonder (Dartmouth College) that was published in *Nature* this past year and covered by papers across the West, including the *Rocky Mountain News*, the *Denver Post*, the *Sacramento Bee*, and both San Francisco dailies.

The basic premise of the study is that continental lithosphere can store up gravitational potential energy (GPE) and that this energy is released through deformation of the continent, sometimes through earthquakes. GPE is built up when the crust thickens in a contractional orogeny or when the density structure of the mantle or crust changes. This is rather like charging a battery; and how the GPE is discharged is similar to how a battery discharges when the terminals are hooked to a resistor. If the resistance is high, the battery discharges slowly and the heat generated is quite low. If the resistance is low, discharge is more rapid and heat greater, the extreme case being a short across the battery's terminals, which produces a lot of heat and quickly discharges the battery. For continents, the resistance to spreading determines how GPE produces deformation. Lithosphere that is relatively cold, such as under the Great Plains, will deform slowly, while lithosphere that is hot, such as in the Great Basin of Nevada, will deform fairly quickly. This relation is similar to how the flow of molasses is determined by temperature. Thus deformation in continents should reflect the interplay of the forces driving deformation (GPE) and those resisting it (determined by the temperature and composition of the lithosphere).

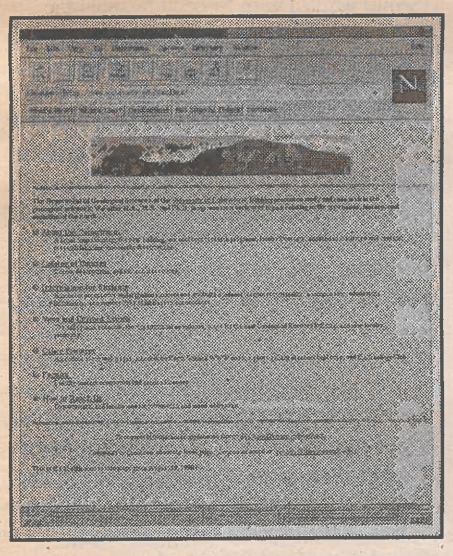
While many researchers have appealed to this mechanism for some time, the new study was the first to measure variations in GPE within a mountain chain, in this case the southwestern United States. Jones and co-workers found that the variations were of the correct sense for the deformation observed geologically, seismologically, and geodetically. Furthermore, applying knowledge of the temperature structure of the lithosphere in the southwestern US permitted the estimation of the deformation rates that should result from dissapation of GPE. These estimates proved to be quite similar to the rates actually observed, thus supporting the premise that GPE is indeed responsible for most of the deformation east of California.

Several implications of this work are now being investigated. One is the possibility of improving estimates of seismic risk in places away from plate margins, where traditional techniques such as extrapolation from an historical seismic record work poorly. Another is to better understand the evolution of mountain belts, particularly the US Cordillera, by using the simple procedures of this study back through time. Already Jones suspects that some of the mysteries accompanying the creation of the Rocky Mountains behind CU can be understood using this concept. So perhaps the next time people are tossed out of bed by an earthquake east of California, the explanation of the cause will be a little clearer.

*continued on page 4*

# The Geology Department Goes High-Tech

The Department is now on the information highway. Our web page is at: http://www.colorado.edu/GeolSci/. Check it out for the latest news.



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## Faculty News, cont.

### Karl Mueller

The past year was an exciting one for Karl's research here at CU-Boulder and on the homefront. August marked the arrival of his second daughter, Taryn, who is quickly growing into a happy little toddler. He and Chris also settled into a house in Broomfield that is quiet and affords views of the Front Range and nearby open space. His efforts to build a program in structural geology and active tectonics in 1996 centered on successfully obtaining funding for work on blind thrusts, fault-related folds, and earthquakes in active transpressive orogens. Two new master's students, Adam Bielicki and Jocasta Champion, are starting their respective projects in the Transverse Ranges of southern California and the New Madrid Seismic Zone of western Tennessee. Karl is also preparing to bring 2 or 3 additional graduate students on-line in 1997 to bring the structural geology and active tectonics program to something approaching critical mass. Publications for the past year included two papers on compressive fold growth and lateral propagation during earthquakes for the *Journal of Structural Geology*, and a paper on the role of tectonic escape in the Los Angeles Metropolitan Area for *Science*. An exciting result of the past year was the successful acquisition and processing of incredibly well-resolved digital elevation models using NASA's raster scanning laser altimeter system. Working with an undergraduate student in the honors program, they also managed to determine the slip rate on blind thrusts in the New Madrid Seismic Zone using geologic data—a first for this region. On the teaching front, he is teaching new courses in spring semester in active tectonics (grad) and structural field geology (undergrad). Both classes will benefit from new field stereoscopes purchased with course fee monies that will be "broken in" during an extended field trip through southern California and during mapping exercises near Boulder and Lyons.

### Mark G. Rowan

Mark was appointed a Research Assistant Professor and an EMARC Research Fellow last year. Although the titles have changed, his activities continue essentially unchanged from previous years. His main research focus is understanding the geometry and evolution of salt-related deformation in the Gulf of Mexico using 3-D seismic interpretation and structural restoration. He heads up a new industrial consortium (along with Paul Weimer and Bruce Trudgill, a post-doctoral researcher) that builds upon the success of the 4-year EMARC Gulf of Mexico program that terminated last year. The new consortium is funded by 20 oil companies to the tune of $400K per year for at least the next three years. It is centered on three modern 3-D seismic data sets donated to EMARC, as well as supporting well and biostratigraphic data, and makes use of the state-of-the-art software and hardware built up in the EMARC computer lab over the past several years. A combination of senior researchers and students will be kept very busy! Mark has also maintained a research interest in the Eastern Cordillera of Colombia. One student, Roberto Linares, finished his MS and returned to work for Ecopetrol in Bogota; two other MS candidates from Colombia started their studies this year. The focus of this research program is to understand the subsurface geometry, evolution, and petroleum potential of the Eastern Cordillera, a Mesozoic rift basin that was inverted during the Andean Orogeny. In addition to research, Mark also has been active in teaching, attending conferences, and consulting. The teaching includes a relatively small load within the department and courses on structural geology and salt tectonics for industry. There has been a lot of travel to Texas and Louisiana, where most of the sponsoring companies are located. While fun during some parts of the year, numerous trips into the humid South last summer almost caused a literal meltdown. Luckily, the odd trip to places like England and Syria kept things interesting.

### Joe Smyth

#### Mineral Physics News: An Ocean in the Earth's Interior?

With funding from NSF's new Cooperative Studies of Earth's Deep Interior initiative, the Mineral Structures Laboratory (http://xtl1.colorado.edu/~p4/Home.html) has embarked on an aggressive program to investigate the incorporation of hydrogen in silicates of the deep Earth. In collaboration with workers at Arizona State University and the University of Washington, the group has identified, and determined the atomic structures of, two new hydrous silicate phases related to the beta-$Mg_2SiO_4$ structure. Beta-$Mg_2SiO_4$ is the stable form of forsteritic olivine at depths of 400 to about 550 km. It is nominally anhydrous, but the new studies show that the phase can incorporate variable amounts of hydroxyl up to an equivalent of 3.3 wt % $H_2O$. This means that the solid phases of the Transition Zone (400-670km depth) of the Earth may harbor a vast reservoir of water many times larger than the oceans.

Work is proceeding on the measurement of the equation of state and elastic properties of the new phases to see how the seismic velocities might be affected by incorporation of hydroxyl. If velocities are strongly affected, it may be possible to estimate the amount of OH actually present in the region.

The crystal structure of calcite III also has been recently determined. Calcite III is a metastable intermediary phase observed in static and shock compression experiments on calcite. Its existence has been known since the early work of Bridgman in 1939, but the structure has never been determined. The structure has now been determined from existing powder diffraction data by Joe working with Prof. Tom Ahrens at Cal Tech. The formation of metastable intermediate phases between calcite and aragonite affects the amount of $CO_2$ that might be released to the atmosphere on a catastrophic impact event into carbonate rocks, as is thought to have occurred at the Cretaceous-Tertiary Boundary.

Joe has recently received additional NSF funding for acquisition of two more diamond anvil high-pressure cells and a laser ruby fluorescence spectrometer to measure pressures in the cells. This system will allow complete crystal structure determinations at pressures of 20 to 30 GPa (=depths to 900 km). Funding has also been obtained for a new computer automation system for the Scintag X-ray powder diffractometer.

Undergraduates Rebecca Preston and Stephen Jacobsen attended the Spring meeting of American Geopysical Union in Baltimore, MD. Steve presented the results of his undergraduate Honors project on the crystal chemistry of thaumasite. Graduate student Henrietta Smith presented her work with Becky on the crystal chemistry of mantle garnets.

### Hartmut Spetzler

Many of the concepts in geological sciences are more easily learned with good visual aids and especially in the field if at all possible. Hartmut is involved in efforts for using high tech in the class room and in communication among faculty and students.

The computer provides new approaches for learning and the dissemination and exchange of information. All faculty are now connected to e-mail and most interdepartmental communication takes place via the net. There do not seem to be any fewer faculty meetings however, but the faculty have fewer excuses for not being informed about the matters to be discussed.

All students, graduate and undergraduate alike, have e-mail addresses, and there are many computers all over campus giving access to those who do not have their own computers.

Hartmut has taken the lead in introducing those of us who are not already computer experts to the power of the computers in classroom teaching. He scrounged funds from various sources and was ingenious in getting expert help from a variety of people, especially Bill Wyman and Tim Neese from Academic Media Services. The department was able to purchase some hardware in the form of notebook computers, scanners and most importantly was able to hire Mr. Xibin Zeng, a graduate student in computer science who has a strong background in geology. Hartmut, Bill and Xibin spent many hours making programs work and standardizing them before offering their services to the faculty and teaching assistants in the department. Tim helped more behind-the-scene and with the finances. The team found out the hard way that what is advertised as compatible and seems so easy in the store or the snazzy computer magazine requires much effort before one can feel comfortable using it in the classroom. Furthermore, all faculty are so busy with their many duties that hardly anyone can afford the time to become a computer guru just to jazz up lectures. The possibilities that the new technology provides for teaching goes far beyond the ability to dazzle students with pretty pictures. This semester (Spring 1997) Xibin has a 50% appointment and is helping faculty and teaching assistants get around the long learning cycle which was required for Hartmut to incorporate multimedia technology into the classroom.

With Xibin's help and under the watchful eye of Bill Wyman, Hartmut has scanned current newspaper articles, retrieved pictures and a movie of solar storms from NOAA via the internet, scanned old slides, and extracted pertinent short film clips from longer video tapes and used them in his lectures. Going beyond the use of previously recorded material, he prepared a program that allows the students to learn about the differentiation of rocks (olivine in this case). A phase diagram comes alive as a model rock changes its partial melt content and the colors of solid and liquid in response to changes in temperature and starting composition. Thus students at the introductory level are able to grasp the processes involved in the differentiation of rocks and do their homework, which involves several distillation cycles.

Students sign up on an e-mail class list. Questions or comments that are submitted to Hartmut by e-mail are answered or commented on directly and, if of general interest, sent out to the class list. The electronically submitted questions as well as those asked in class often determine part of the content of the next lecture. Instead of electronic communication making the interaction between student and professor less personal, it quite often provides the impetus for an office visit. The correct use of the new technology is helping students to learn difficult subjects more easily and make otherwise dry matters more palatable. The big danger for professor and student alike is the lure of the internet and becoming sidetracked by the many sources of information; somewhat similar to first discovering the multitude of information in a good library, except here it is all available at the click of a mouse. The reader may wish to visit the department on the net by logging into: http://www.colorado.edu/GeolSci/. Be careful—with all the links to fascinating material you may not reemerge for some time.

### James Syvitski

Professor Syvitski, new research scientist Lincoln Pratson, and PhD student Mark Morehead continued to make strong advances in developing computer simulation models for use in the investigation of basin stratigraphy. Syvitski and Pratson hosted two workshops for the Office of Naval Research (ONR) on simulation studies of the development of continental margin. Held in San Francisco and Boulder, the workshops were attended by scientists and engineers from across the US. Contributions were also made to a third workshop on investigating river plumes flowing into the ocean under flood conditions; the workshop was hosted by ONR at its Arlington headquarters. Syvitski also represented ONR's STRATAFORM project at a classified Naval workshop on high-frequency acoustics, hosted by the Colorado School of Mines. Pratson was honored by representing the geology and geophysics community in helping the Navy shape the future direction of ONR. Syvitski's presentation of simulation developments by the STRATAFORM project attracted a lot of attention from oil company geologists at a Numerical Experiments in Stratigraphy Symposium, held in Lawrence, Kansas. The symposium led to meetings with Mobil in Dallas and Boulder: Mobil has agreed to financially contribute to the ONR STRATAFORM project through support to CU. A Mobil postdoctoral fellow will work at CU's INSTAAR to bridge the high-resolution interests of the Navy with the more geological interests of an oil company. Other STRATAFORM meetings included a two-day session at the American Geophysical Union annual meeting in San Francisco. Students interested in these efforts and approaches to understanding stratigraphy should watch for the every-other-year offering of GEOL 5370 Quantitative Dynamic Stratigraphy. Its launch in 1996 was much appreciated by the graduate students who found themselves immersed in the world of sediments, algorithms and numerical techniques.

Professor Syvitski also advanced his other interest in understanding how sediments accumulate on glaciated continental shelves. Visiting Scientist Dr. Hee Jun Lee of Korean Ocean Research Development Institute (Seoul) worked with Syvitski to apply the concept of sequence stratigraphy to interpreting glacial sequences. Dr. Lee has since returned to Korea, soon to be replaced at INSTAAR by visiting scientist Dr. Robert Whittington, a marine geophysicist from the University of Aberyswyth (Wales). Visiting scientist Dr. Ida Leone (Norsk Polar Institu combined her expertise in investigating mo rainal outcrops using lithostratigraphic and ground penetrating radar approaches, with Syvitski's data on high-resolution marine seismics, to develop new models for interp ing offshore morainal deposits. Highlights these efforts will appear in a new geophysi atlas and a special issue of the journal *Ma Geology*, both sponsored by the internatio COLDSEIS effort led by Syvitski and Ma Stoker of the British Geological Survey. Syvitski combined forces with scientists f Appalachian U., Northern Illinois U. an Dalhousie U. to work on understanding modern processes ongoing in Glacier Ba Alaska. New graduate student Damian O'Grady took over new image analysis t niques developed by summer student E Hutton (UBC) and applied these to int how glacimarine sediment is introduced and settles out in these Alaskan deep fj Syvitski was hosted by the Norwegian logical Survey (Trondheim) and the U sity of Bergen to help link American re with Norwegian efforts. Science coord remains active in pursuing 1) the use nuclear submarine for investigating th physical character of the arctic seafloo Nansen Arctic Drilling Project for ob long rock cores in the arctic; and 3) t sian-American initiative for studying interactions on the Eurasian contine margin.

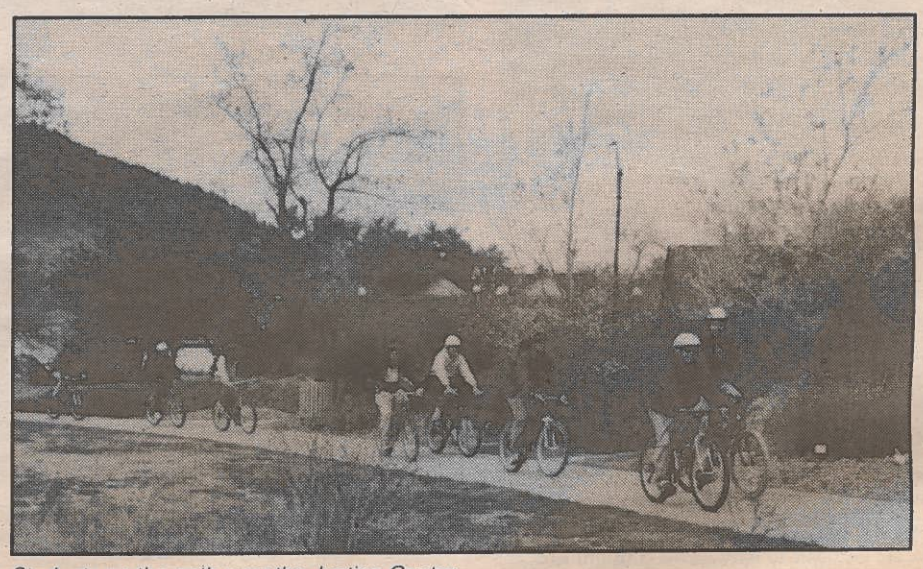
## The New Laboratory Manual

The first-semester introductory geology laboratory exercises have undergone a major change. Over the years, profs like Bill Bradley, Ed Larson, and Pete Birkeland have added new field trips to the labs so that now we can run a lab with mainly field trips. The ideal sequence is as follows: several weeks of rocks and minerals, followed by a trip to the polished rocks of the 9th street cemetery; Flagstaff Mountain to study granitics, erosion surfaces, contact corner, and landslides (the old one the Flagstaff House is built on, and the young ones that have caused the road to be closed in recent wet springs); Lee Hill Road for the local sedimentary rocks; Coal Creek Canyon for metamorphic rocks, soils and the Rocky Flats alluvial fan and contaminant plume; glacial geology of the Nederland area—moraines, tors, grus and soils; a bike field trip down the Boulder Creek bike path (see photos, right). For students that do not own bikes, we rent one for them. We start at the mouth of the canyon measuring discharge and the size of the boulders in the creek. With that information, the discharge of the big floods is estimated, thanks to Bill Bradley's research. With that information we calculate if the space under the bridges is large enough to handle the floods. Then we calculate the rate of sedimentation in pools the city has constructed in the channel. The idea here is to give students experience making field calculations that have a purpose. The next trip is a walking one through the park adjacent to Chautauqua, combining topographic map reading, compass reading, and geological observation. The last trip is to view a variety of landslides along the hogback, see a "fleecing of America" flood control structure up by Jim Munoz' house, and calculate the erosion rate of a small watershed within a subdivision (Pinebrook Hills).

The editors of the guidebook, to be sold at the bookstore, are Val Sloan (graduate student studying rock glaciers in the Yukon) and Pete Birkeland. Depending on how the time goes, Val may put the guidebook on the department web site—there is it, the virtual field trip!

*Val Sloan's class on the Boulder Creek biking field trip.*

*Val explaining the Manning equation to student Terry Church.*



*Students on the path near the Justice Center.*

## How Recent Graduates Grade the Department

As part of the Department's self-study, we asked undergraduate alumni from 1989-1995 to help assess our undergraduate programs. Fifty percent of this group responded, which the University tells us is above average and indicative of an alumni population that truly cares about the Department. Some of the survey results surprised us, others were predictable. We included many of the insights gained in our final self-study report and they will be the focus of future discussions and actions as the Department continues its commitment to providing the best possible undergraduate experience.

In general, these recent alumni indicated that the undergraduate program produces reasonably satisfied graduates, but that it is weak in conveying non-academic skills such as the use of computers in geology, oral presentations, technical writing, and group problem solving. In hindsight, these recent graduates also wished that they had received more extensive career advising and more exposure to applied geology, especially in the environmental field. These comments are not unique to our alumni; they are also reflected in a variety of employer surveys, the educational panels of various professional groups, and are indicative of evolving expectations of colleges and universities in general.

Some survey results quantified perceptions about the major that the faculty have long held to be true. In particular, only 30% choose Geology as their major before entering college; most (>50%) get turned on to the Geological Sciences in an introductory class taken as an elective. This means we must keep using our very best teachers in the introductory courses. It was also confirmed that nearly all majors (90%) intended for the geosciences to be their career field, yet slightly less than 60% are still in the geosciences. The attrition is probably related to the fact that many of our majors do not go on to seek masters degrees. We routinely advise students that the MS is widely regarded as the professional degree in our discipline, and also that a 4-year BA/BS in the American system is not equivalent to the 5-year BS that prevails throughout the rest of the world. Due to poor job and career prospects with just a bachelors degree, about 25% of the survey respondents stated that they would not choose Geology as their major again.

About 33% of the graduates who responded report that they sought or are seeking advanced degrees in the geosciences, and another 10% have sought or are seeking additional degrees in other fields (business, law, environmental sciences). Of those two groups, 75% intend to stop at a masters or its equivalent. Of those currently working in the geosciences or a related field, they appear to be equally split between resource industries, environmental firms, government agencies, and education (K-12). About 55% of the majors felt they had good to excellent preparation for their first job or graduate school. The faculty were disappointed by this number and they want to see it much higher when we conduct our next self-study in six years.

Regardless of what the surveyed alumni are currently doing, they expressed high levels of satisfaction with the enthusiasm of the faculty, opportunities for interaction with faculty, faculty interest in the students, upper-division course work, and the quality of laboratory and field experiences. They were less satisfied with career advising, the quality of laboratory equipment, the amount of "practical" field and laboratory experiences, and the development of job-related skills such as computer applications and writing and speaking skills.

The faculty are committed to improving the Department's overall performance. In particular, David Budd is exploring new ways to deliver career advising, new courses such as Environmental Geology (Budd) and Critical Thinking in the Environmental Geosciences (Farmer, Cole) are being added, and the search for a new faculty member in low-temperature aqueous geochemistry continues. The new building will have a vastly improved computer lab, and plans are being made (Mueller, Sheehan) to more fully integrate computer applications into a variety of courses. The new building and new equipment will also help improve the quality of the laboratory classes. Some of the Department's recent program changes, such as the Environmental Geoscience option, the faculty-undergraduate mentor program (see related story), a course, "Writing in the Geosciences," and the varied field options (see related story) address some of the suggestions made by those who graduated three or more years ago.

We thank all of the alumni who participated in the survey for the time they spent in responding and for their comments. The success of the undergraduate program must constantly be monitored, and it is the alumni who define that success.

**Share your news . . .**

We prepare our annual newsletter during February, and would like to include any significant professional or personal information you may wish to share with us. Your response should be sent to:

Newsletter Editor
Department of Geological Sciences
Campus Box 250
University of Colorado
Boulder, Colorado 80309-0250

## *Rocky Mountain News* article on the Boulder Seismic Network

Undergraduate major Noah Hughes (see photo) and Assistant Professor Anne Sheehan were both featured in a story in the *Rocky Mountain News* on seismic hazards in the Front Range of Colorado. Hughes was involved in the installation of an earthquake seismic network in Boulder County as part of the field geophysics course taught by Sheehan, and is completing analysis of the earthquake data for his senior honors thesis. The network recorded numerous small earthquakes in the Boulder area as well as distant teleseisms from places such as Japan and South America. The equipment used in the network was purchased using an NSF Undergraduate Education Laboratory Improvement grant, supplemented by funds from the department, CIRES, and the University.

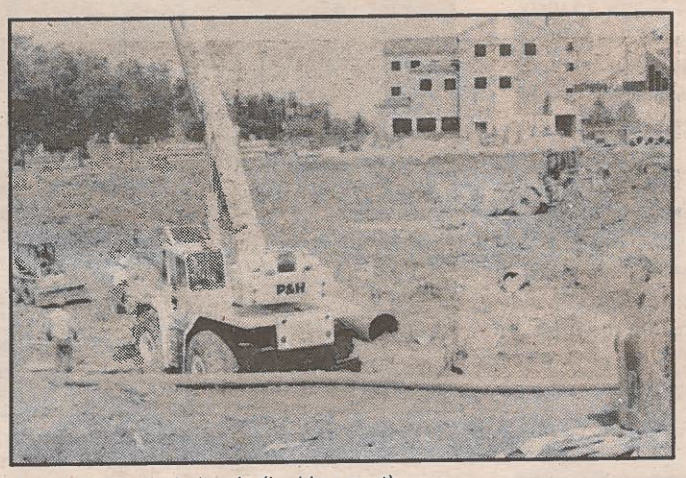
*Noah Hughes servicing earthquake seismic station on Sugarloaf Mountain.*

# Building Dedication in October

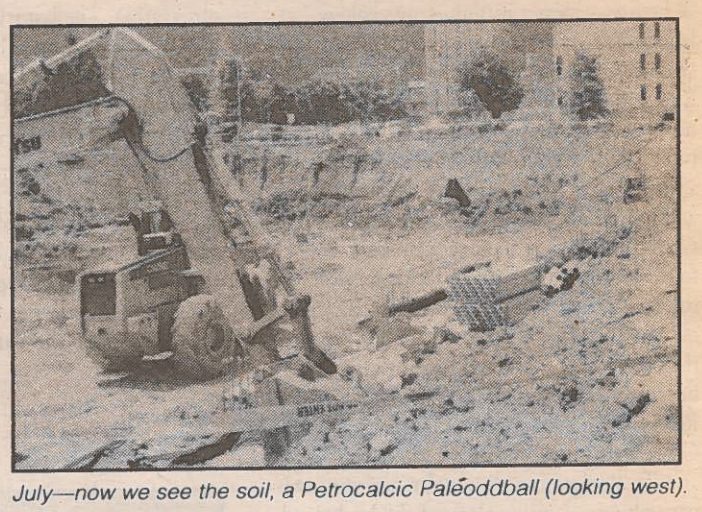
**A** bang-up dedication ceremony and accompanying festivities are planned to formally incorporate our jewel of a building into the CU campus. The date agreed upon by the Chancellor (it's his party), the CU Foundation, the Department and the principal donors is October 30, 1997. All 2,200 of you reading this announcement are invited to join in the festivities. However, since the building isn't designed to hold that many, we will need to know in advance whether you plan to come so that we know what size tent to order. Please call or e-mail Beth Hanson (303-492-2330; hansonb@colorado.edu) on or before September 1, 1997 if you can join us.

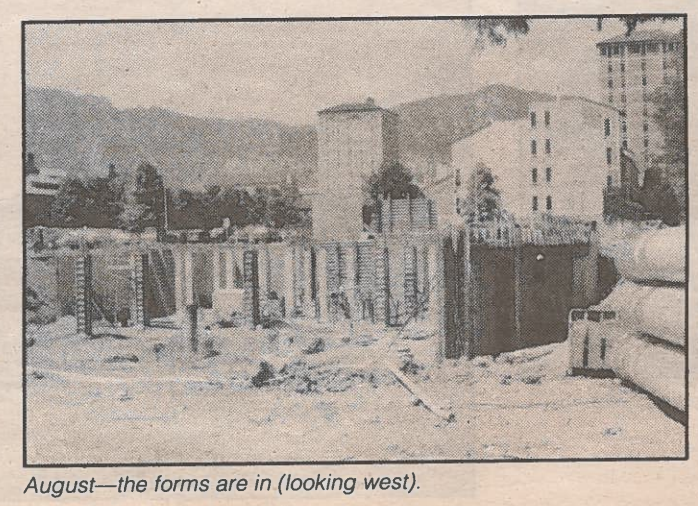
There are further treats in store. From 9-12 that morning a colloquium will be held in the auditorium featuring six of the department faculty speaking on topics that cover the full range of research being carried out in Geological Sciences at CU. Lunch will be on your own, and after that there will be informal tours of the building. At 3 p.m, we will convene in the auditorium to hear remarks by the Chancellor and President, introductions of our principal donors, Bruce Benson and Eric Johnson, and our keynote speaker, geophysicist extraordinaire, Don Anderson from Caltech. Don is a member of the National Academy of Sciences and ex-president of AGU. He ran the Seismolab at Caltech for many years and is also a poet. He will speak on the excitement of the Earth sciences and their relevance to issues of the next century. We are fortunate to have such a consummate Earth scientist to help dedicate our new facility.

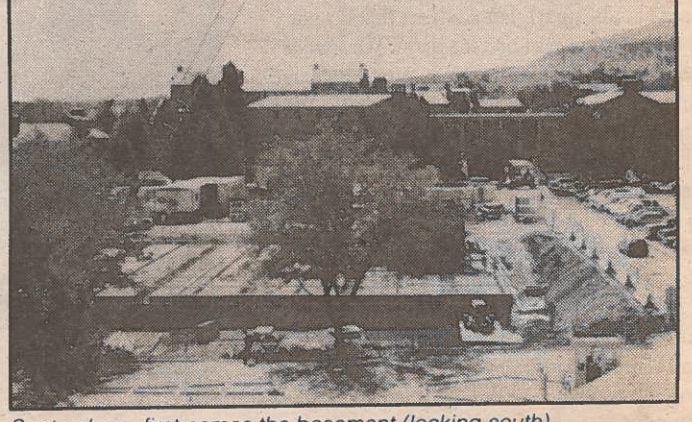
Following the speeches there will be a reception culminating in the ceremonial dedication of the building and the Jerry Crail Johnson Earth Sciences Library. We have been waiting for this day for more than a quarter of a century and many of you perhaps even longer. Please come help us celebrate!



*June—let the hole begin (looking east).*

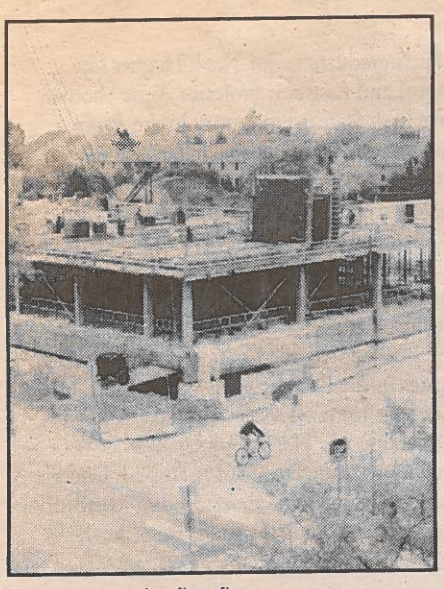

*July—now we see the soil, a Petrocalcic Paleoddball (looking west).*

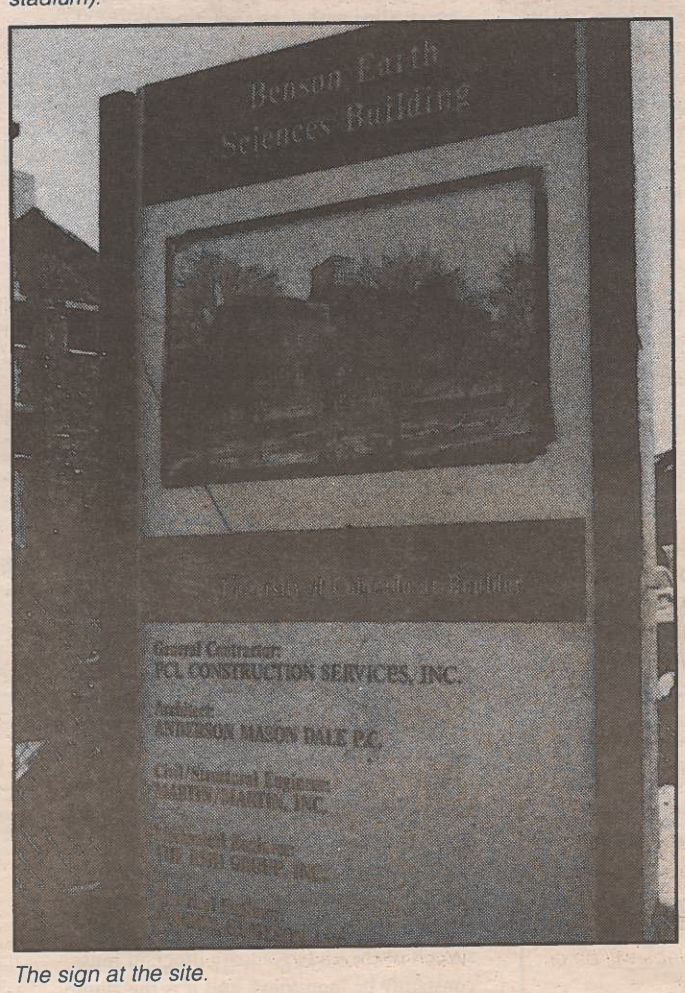

*August—the forms are in (looking west).*


*September—first comes the basement (looking south).*

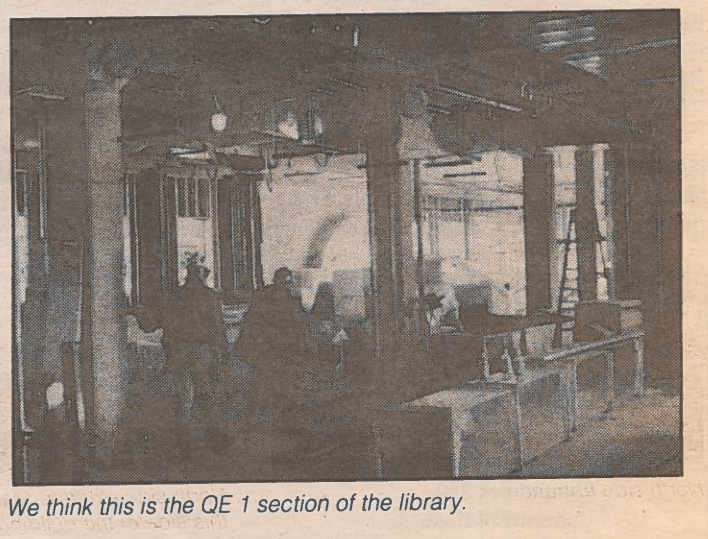

*October—the third floor is being completed (looking south from stadium).*

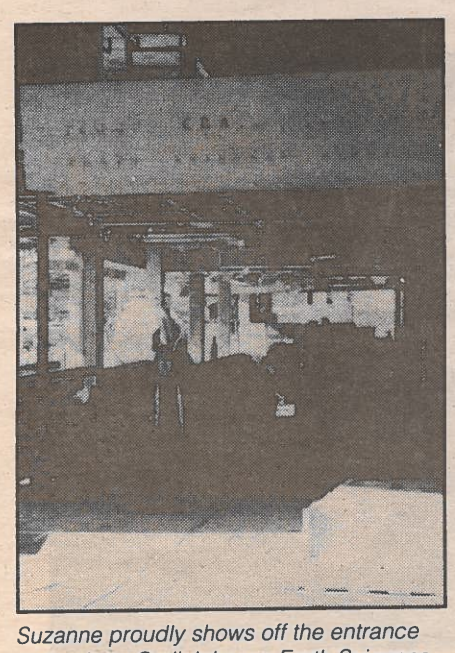

*December—looking west over the Math Building entrance. The fourth floor is nearing completion.*


*September—the first floor.*



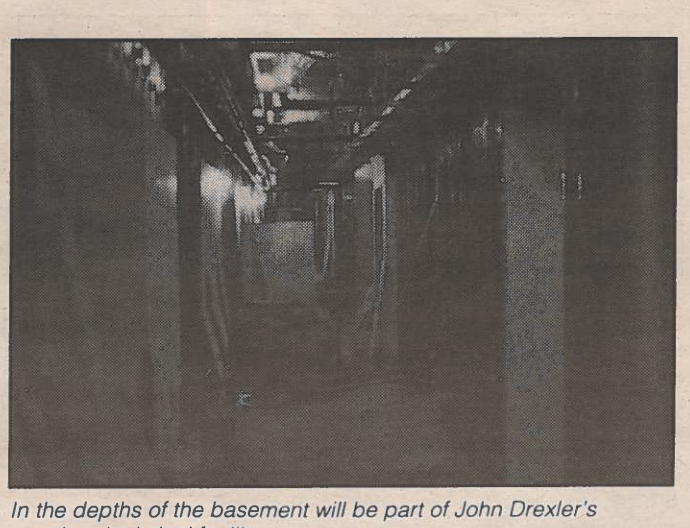
*The sign at the site.*


*We think this is the QE 1 section of the library.*

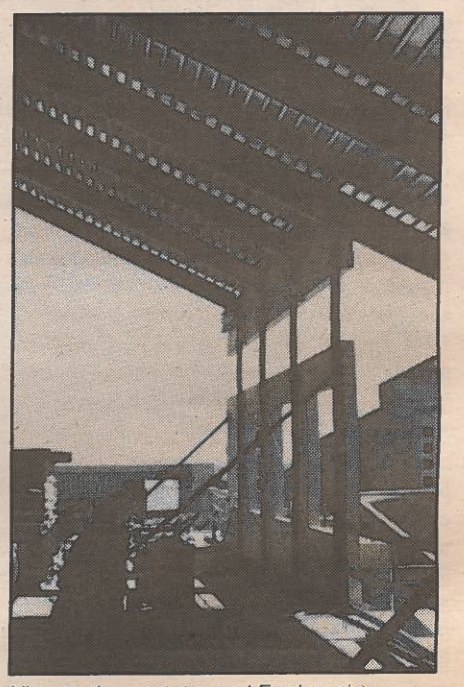

*Suzanne proudly shows off the entrance to the Jerry Crail Johnson Earth Sciences Library.*

# GEOLOGY NEWS

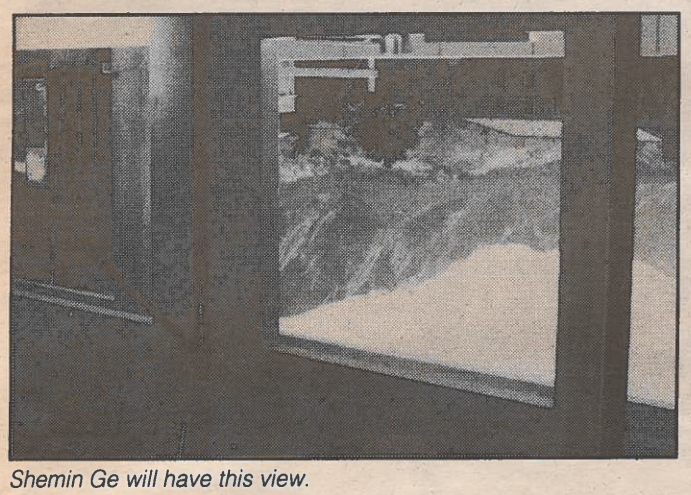
*Suzanne explains to Bill Braddock that, yes, there will be a roof over his future computer classroom.*



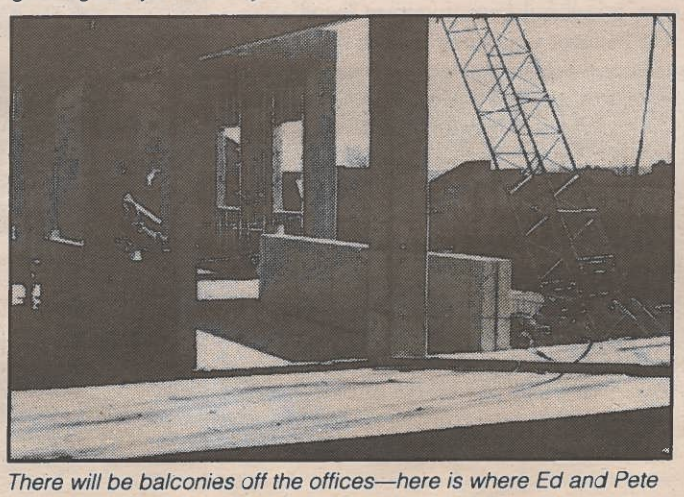
*In the depths of the basement will be part of John Drexler's growing analytical facility.*



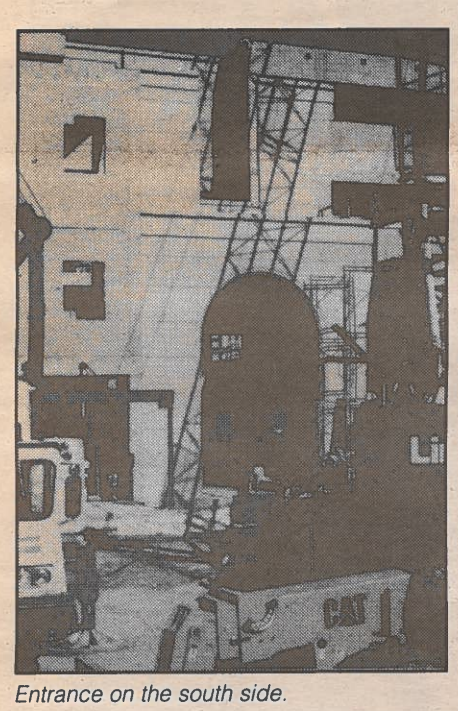
*View to the east, toward Engineering.*



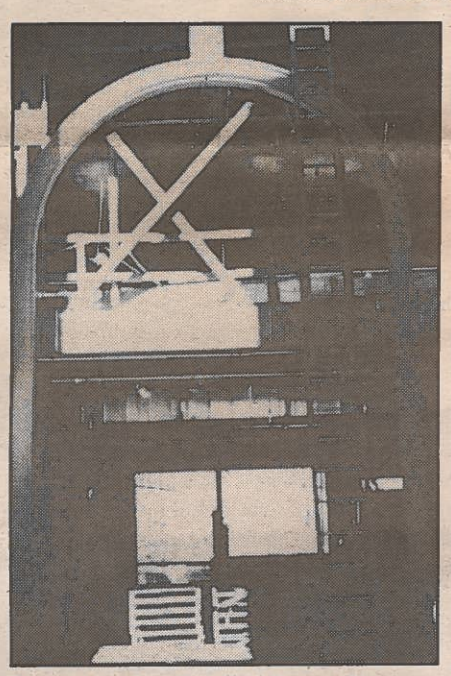
*Shemin Ge will have this view.*



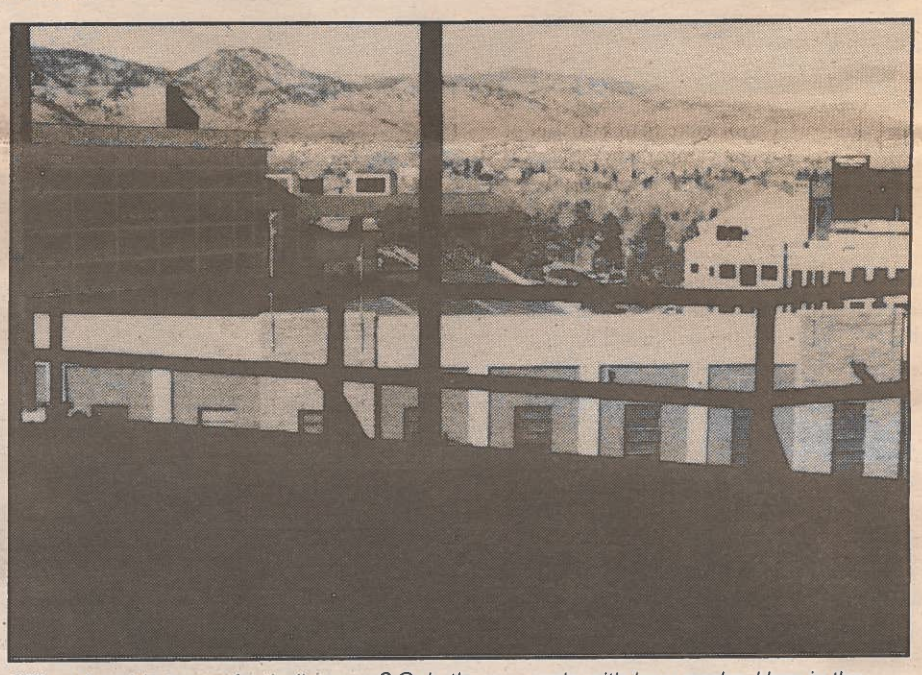
*There will be balconies off the offices—here is where Ed and Pete will read the* Wall Street Journal.



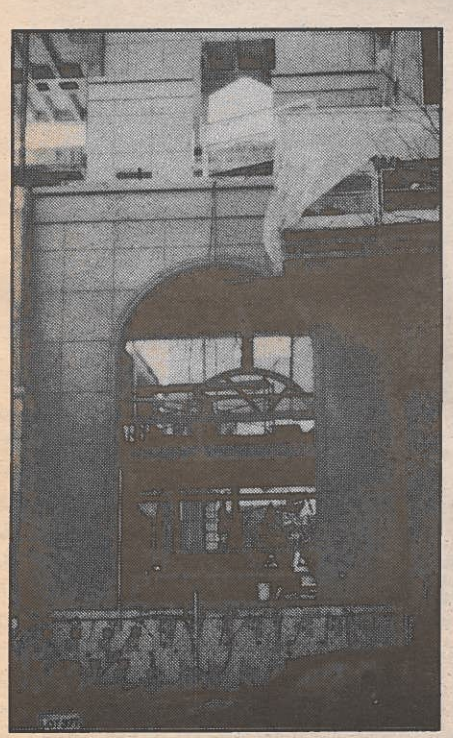
*Entrance on the south side.*



*Atrium after entering from the south.*

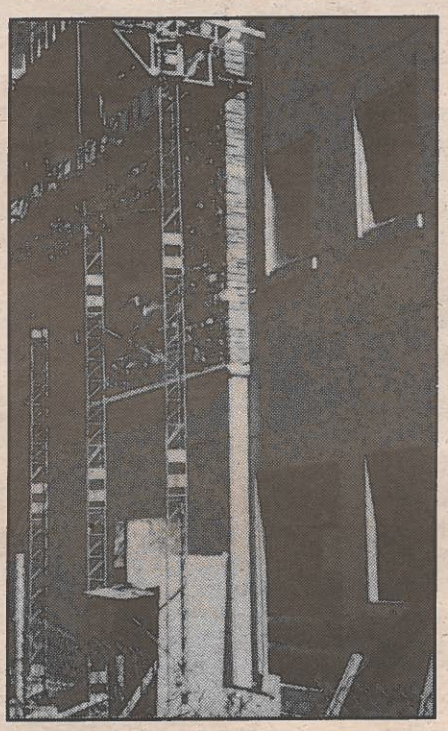


*Will we be able to see football games? Only those people with long necks. Here is the view from an upper story lab toward the stadium.*



*North side entrance.*

*North side exterior. Many labs will be on this side of the building.*



*West side exterior.*

**One year in the life of a building.**

# FIELD GEOLOGY

When Bill Braddock retired, the Department had to evaluate how to deliver field geology experiences to its undergraduate majors. With input from the Department's Advisory Board, we concluded that we should develop field skills earlier in a student's undergraduate career, expose more than just our own majors to field geology, and take advantage of our diverse faculty to offer a greater variety of field experiences. We believe that the most important objective is teaching students how to approach and solve field-related problems. The critical skills are generic ones: locating oneself on a topo map, assessing what one is observing, describing and collecting representative data and samples, interpreting geologic relationships, and determining the three-dimensional distribution of geologic features. A good field program produces students with competency in these skills regardless of whether the exercises involve complex structures, the position of the water table, thickness of a stratigraphic section, glacial deposits, a contaminant plume, an igneous complex, or a geophysical anomaly (see photos).

The result of this evaluation is a new field program that consists of a series of two-credit field geology modules. Each major must take three of the modules. Courses required for graduation must be offered during the regular academic year, so we continue to teach most of these modules in the fall and spring terms. Each class meets twice per week from 12-6 p.m., which equates to a two-week summer field course. Combined, three modules equate to a six-week summer field course.

The first of the field modules is a sophomore-level course required of all majors. Its only prerequisite is an introductory sequence to the geosciences, which for most students is physical and historical geology. This single prerequisite allows students in other majors, such as Geography, Biology, Anthropology, and Environmental Studies, to also take the course. Pete Birkeland and David Budd teach this module in the fall, spring, and summer terms. They emphasize basic field skills, which include use of a Brunton compass and topo map, identification and description of rock types and units, measuring traverses, determining the thickness of units, and mapping in relatively simple terrain. David is also introducing GPS technology this spring (1997). Veterans of field geology with Larry Warner or Bill Braddock will remember some of the localities we still use—Lee Hill Rd., Bear Creek, Six-Mile Fold, Flagstaff Mt., Left Hand Canyon, Eldorado Springs, and the Mt. Sanitas valley.

The sophomore-level field course and appropriate upper-division courses in either sedimentology, stratigraphy, structural geology, petrology, hydrogeology, geochemistry, physics, or geomorphology are prerequisites for the advanced field-geology modules. These two-credit courses emphasize field experiences in specific subdisciplines of the geosciences. We try to offer at least two different advanced field modules per semester, and one in the summer term. Two modules on the books, but not yet taught, are in stratigraphic sciences and paleoenvironmental techniques.

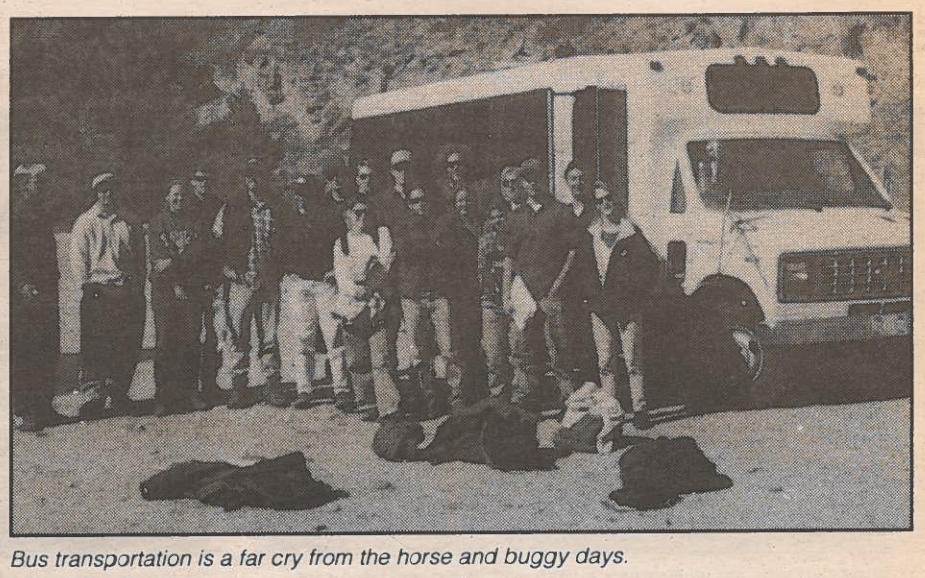
Maureen McHugh and Jocasta Champion in Clipper Mine.

One of the most popular advanced field modules has been Chuck Stern's Igneous and Metamorphic Field Geology. This course includes a number of exercises in the Boulder area that focus on Proterozoic (Idaho Springs Fm., Boulder batholith, Iron dike, and Laramie anorthosite) and Tertiary (Sugarloaf stock, Valmont dike, and Table Mt. basalts) rocks. However, the most popular portion of the course is two long weekend trips to northern New Mexico where the students explore more recent igneous activity in the Spanish peaks, the Capulin volcano, the Taos volcanic field, and the Valles Caldera. Camping out adds a distinctive flavor to the entire experience, as well as the opportunity to "bond" with Professor Chuck over an open fire and a traditional field beverage.

Structural Field Geology is the second advanced field module. Bill Atkinson taught it for the first time in the Spring of 1995 and included quite a bit of mapping in the underground mines of Boulder County. Karl Mueller has taken over this module and is teaching it this spring (1997). His objective is to combine mapping of local fault and fold systems near Boulder with analysis of fabric elements. Last year Karl and Bill developed new exercises for Six-Mile Fold that use 1:5000 scale color photographs for mapping and also require the students to gather detailed bedding, cleavage and slickenfibre data for subsequent analysis with stereonets. This year Karl will also have the students work on fold and fault systems at Rabbit Mountain and Carter Lake near Fort Collins.

Field Geophysics is taught by Anne Sheehan and was offered for the first time in Fall 1996. The emphasis of the class is hands-on applications of geophysical techniques in the field, with follow-up analysis on computers. Shallow subsurface applications at scales appropriate for environmental and archaeological studies are the primary focus. Last fall, class projects included a seismic refraction and electrical resistivity study of groundwater resources in the village of Eldora, a gravity and seismic refraction study of the Ogallala aquifer's recharge zone near Ft. Lupton, a magnetics study of Valmont dike, and the establishment of an earthquake seismic network centered on Boulder. Individual student projects included using gravity data to map the distribution of abandoned coal mines near Louisville, determining the depth to bedrock at Florissant Fossil Beds National Monument, a ground-penetrating radar study at archaeological sites in Utah and New Mexico, and an electrical resistivity study at an archaeological site near Golden. The USGS Branch of Earthquake and Landslide Hazards helped by providing a demonstration of high-resolution shallow seismic reflection, and Jerry McJunkin of Terraplus Inc. demonstrated and loaned ground-penetrating radar equipment.

John Drexler designed the Environmental Geochemistry field module to provide students with the basic field skills required for characterizing environmentally sensitive materials. Methods include the sampling, preservation, and analysis of solid and aqueous media in a legally defensible manner. Students also get experience with GPS, air photos, QA/QC issues, background determinations, and data presentation. One project is the mapping and characterization of heavy metal concentrations in soils around an old smelter site north of Boulder. A second requires students to determine the impact of the Argo Tunnel on the metal load of Clear Creek. This is a great project for the students to look at acid mine drainage, its chemistry, and how point sources affect water quality. A third has the students characterize the chemistry of Boulder Creek from above Eldora to 95th Street east of town. With this project,



Bus transportation is a far cry from the horse and buggy days.

Shemin Ge and class measuring the water table from domestic wells in the town of Eldora.

the students assess how rock weathering and municipal, industrial, and agricultural processes affect water quality. They also learn how to measure stream flow, install lysimeters, and conduct microbiological surveys.

Pete and Shemin take time away from preparing this newsletter to teach a two-week summer module. The first week focuses on surficial geology techniques, and Pete has several exercises. One is to learn (of course) the description of soils. This is followed by a mapping exercise on fluvial terraces and a final project on landslide mapping, of which the Dakota hogback provides some great examples. Pete finishes his week along the Peak-to-Peak highway mapping glacial geology via bikes. Pete believes that bikes are the most efficient way to do road cut geology, and he tries hard to convince the students of this fact. In the future, he may take the class into the alpine country to map moraines, talus, and felsenmeer.

In the second week of this summer class, Shemin teaches some basic hydrogeology field techniques. First, groundwater tables are mapped at a site in Golden and another in Boulder. The students also learn how to determine hydraulic conductivities in the Boulder Creek alluvial aquifer by performing aquifer tests with pressure transducers and a hermit data logger. They also measure flow rates for several major streams running through Boulder. A final and more comprehensive field exercise is the documentation of the contaminate plume sourced from an outhouse (not Pete and Sue's) in the village of Eldora. This exercise forces the students to integrate the techniques and concepts they have learned in the entire two weeks, as they must collect data on the surficial geology, groundwater levels, and nearby stream flow rates.

These summaries of our new field program clearly reflect how the geosciences have evolved over the last 15 years, with the increased profile of environmental geology being just a part of that evolution. Our new

Seismic refraction exercise in Eldora.

The Jacob's staff is still the stratigrapher's best friend.

and varied field modules provide students with a wide variety of experiences and opportunities that still teach the fundamentals of observing, recording, and deciphering geological relations in the field. What also remains a constant is that field geology is fun!

# Erle Kauffman moves to Indiana

Erle Kauffman left CU for the University of Indiana this past summer. His wife, Claudia Johnson, took a job in Bloomington. Commuting back and forth was getting to be a burden, so when he also was offered a position there, he packed up his many rocks and books and took off in August. A send-off party was held in Koenig Alumni Center (see photos). Erle made many contributions to the program here, and we will begin with his earlier career, as written by Larry Warner.

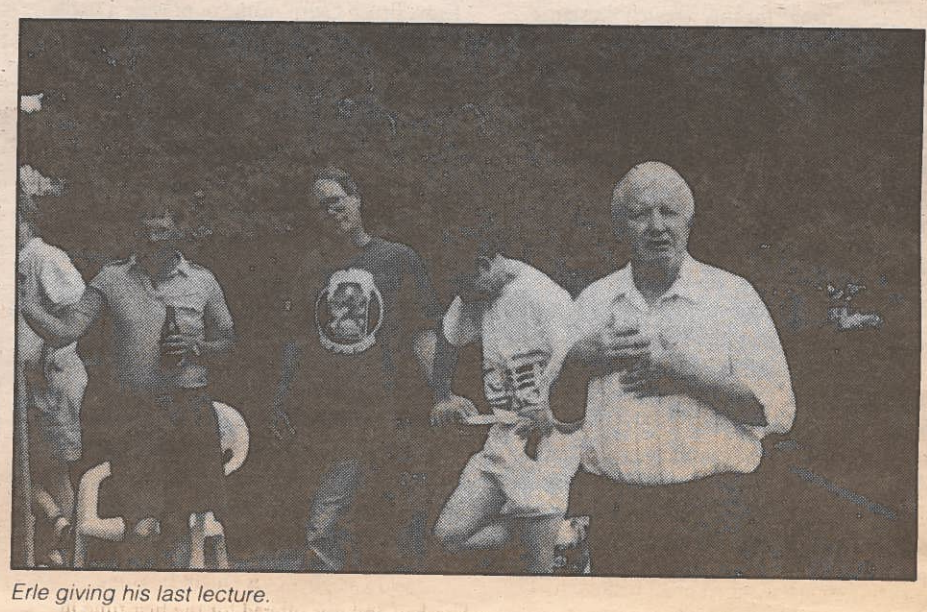
Erle arrived here in 1980. He left the curatorship of the Dept. of Paleobiology at the U.S. National Museum, Smithsonian Institution, to join the department as chairman. Prior to working with the Museum, he completed three degrees at the Univ. of Michigan (BS, MS, PhD). In conjunction with his museum work, he served as Adjunct Professor at George Washington University and as a lecturer for Smithsonian Associates and the American Geological Institute. He was a visiting professor at Oxford University, England ('70-'72), University of Tübingen, Germany ('74), and CU in '77-'79.

Since his arrival, Erle helped revamp course offerings to include, beyond the basic courses, seminars on a variety of subjects, taught by himself and colleagues from government, industry, and professional societies. Student interest in paleontology was revived following the retirement of John Chronic, thanks to both Erle and Don Eicher.

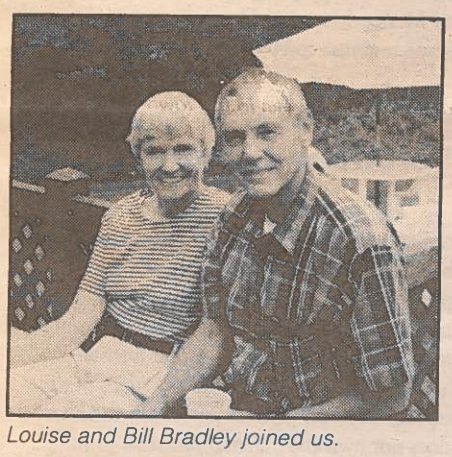
Erle's research interests cover a wide range of topics in paleobiology. Included are studies in evolutionary theory, rates, and patterns; systematics of late Paleozoic-Cenozoic mollusca; geochemical analysis of molluscan environments; studies of sedimentary cycles; refinements in Cretaceous-Paleocene geochronology; basin analysis of epicontinental seas; and research on the influence of extraterrestrial forces and events on geologic systems. In connection with the last, he has contributed paleontological arguments to the debate concerning the causes of mass extinctions. Erle was a prolific writer and an invited speaker at many colleges and universities around the world. Many of his colleagues visited him in Boulder. He was a Distinguished Lecturer of the AAPG ('84), President of the Paleontological Society ('82), and Vice President of the International Paleontological Union ('86).

During his term as Chair ('80-'84) we undertook a major self-study of the department, made curriculum changes, expanded the staff and faculty, increased funding for research and students, made more efficient use of building space (read this to mean we had Erle move his multitude of boxes of rocks and fossils out of the halls!), and a new building was proposed (and denied). These were busy times.

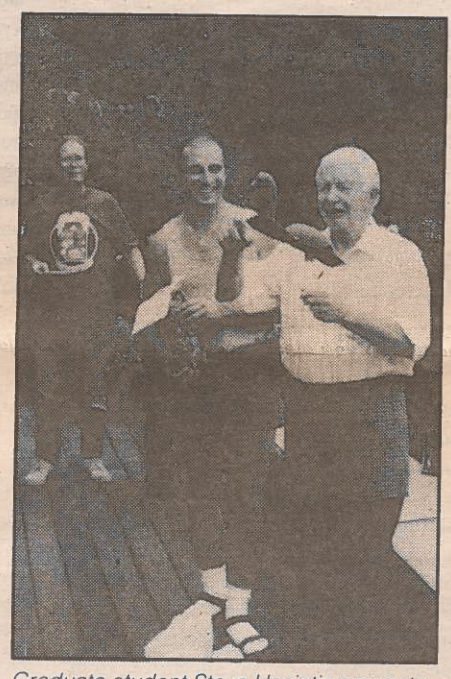
Erle Kauffman's going-away-party.



Erle giving his last lecture.



Louise and Bill Bradley joined us.



Graduate student Steve Hasiotis presents Erle with a pink flamingo.

Don Eicher gave the speech on behalf of the department.

Alums Meche and Tom Doyle, with graduate student Eric Hiatt in the middle.

Claudia Johnson, Marilyn Fagerstorm, Jack Edwards, and Sue Birkeland.


The cake says it all!

# Colloquium, Fall 1996

The departmental colloquium covered a variety of subjects. Following are the speakers and their topics. Local alums are especially invited to join us at the Colloquium.

**Bruce Jakowsky** "Life on Mars?"
**Bill Atkinson** "Obvious Places to Find Gold"
**Richard Tocher** "The Hwy. 93 Landslide at Golden"
**Chris Neuzil** "Groundwater Hydrodynamics of an Ultra-low Permeability Shale"
**John Rundle** "New Ideas about Earthquakes"
**John Andrews** "Patterns, Processes and Problems of Iceberg Rafting in the N. Atlantic as a Measure of Ice Sheet History"
**Leonardo Seeber** "The Nanga Parbat Antiform and Strain Partitioning along the Himalayan Arc"
**Gene Humphreys** "Western US Tectonics and Magmatism: Contributions from Plate Motions and Other Mechanisms"
**H. Laubscher** (AAPG Distinguished lecture) "A New Adventure in Alpine Tectonics: Transorogenic Connections of Foreland Thrusts Across the Miocene Alps"
**Steve Wesnousky** "Crustal Response to Lake Lahontan"
**Bill Bassett** "What We Can Learn About Water from Diamond Anvil Cell Measurements on Clay"

## The Department Continues Engaging Undergraduates in the Research Enterprise: Mentoring Program for Geology Majors

Many undergraduates remain uncertain about the possibilities available to them as Geology majors and lack access to professional information. Their experience with our discipline is too often limited to the classroom; rarely have they been engaged in the excitement of geological discovery. To alleviate this situation, the Department initiated a Mentoring Program in 95–96 with financial support from alumnus Bruce Benson and the Shell Foundation. The goal of the program is to simultaneously enhance the educational environment for undergraduate majors and to facilitate research in the Department. Funds are being used to allow graduate students and faculty to incorporate undergraduates in their research, either in the field or in the laboratory. In exchange for this research assistance, each sponsor assumes a one-on-one mentoring responsibility for an undergraduate major, providing advice on professional development, graduate school, and employment opportunities. The Department holds informal social gatherings for mentors and mentorees during the academic year.

Our initial goal was to secure funding for the program for at least three years, after which we would evaluate its success. Response to date indicates that mentoring is indeed one of the most effective investments we can make in our program. The undergraduate majors benefit by exposure to the research environment at an early point in their career, and by developing personal ties to graduate students and faculty. Faculty and students have access to motivated assistants as they pursue their research objectives. And our ability to recruit outstanding new majors from the general student body is enhanced as word of the program grows. The University recently recognized our Mentoring Program as one of the best examples on the Boulder campus of personalizing the educational experience for undergraduates.

Based on this feedback, the Department is moving to secure long–term funding for the mentoring program. Several alumni have recently made contributions specifically in support of the program, and private sector sources have indicated that they will make designated donations in support of the mentoring program through the CU Foundation. We are also working with the Foundation office to develop an endowment in Professor Bruce Curtis' name to provide a stable funding base for the program. Bruce's commitment to his students was particularly effective, and an endowment in support of personalized instruction in his name reflects that commitment. To date, contributions from alumni to this fund exceed $100,000; our goal is a $500,000 endowment.

For the 1996–1997 fiscal year, the second year of the program, the Department awarded 25 Mentoring grants, averaging $1,000 each. Response from the students and their mentors has been uniformly favorable. A list of mentor projects and individuals involved is tabulated at right. On behalf of our undergraduate majors, faculty, and graduate students, we extend our thanks to those individuals and corporations whose generous support allows us to offer this program.

| Mentor | Mentoree | Project |
|---|---|---|
| John Andrews<br>Donnie Barber<br>Anne Jennings | Jon Funk | Clay-mineralogy of glacial marine sediments, SE Baffin Island slope and Labrador Sea |
| Pete Birkeland | John Russell | Graphics and illustrations for revision of soils book |
| David Budd | Elizabeth Shannon | Cenozoic carbonates of Florida |
| Emmett Evanoff | William Hughes | Paleoenvironments of the Bridger deposition |
| Lang Farmer | Seth Mueller | Learning about the laboratory techniques involved in chemical separation of Rb, Sr, Sm, Nd, and Pb from natural materials |
| Shemin Ge<br>Gordon McCurry | Colin Craven | Surface water and groundwater interaction |
| Steve Hasiotis | Kristin Kupersmith | Quantitative evaluation of Mesozoic and Cenozoic insect nests and cocoons to understand behavioral and reproductive stasis |
| Eric Hiatt | Alex Krolick | Comparison mineralogy determined from X-ray diffraction |
| Mike Kaplan | Kay Eastman | Late Quaternary ice-sheet dynamics |
| Mary Kraus<br>Tina Wells | Amy Crandall | Fluvial sedimentology and paleosols of the Fort Union Formation |
| Alan Lester | John Solsulski | Analysis of magnetic susceptibility variations within the Sage Creek White Layer |
| Kathy Licht | Dennis Duran | Glacial history of the Ross Sea, Antarctica |
| S. Martinez-Alonso | Kathy Bulicki<br>George Papic | Use of illites to get temperature of formation of hydrothermal deposits |
| Karl Mueller | Jessica Jennings | Testing the viability of structural and geomorphic models of active folding in central California |
| Paul Murphey | Benjamin Burger | Stratigraphy of the Upper Bridger Formation |
| Andrew Pulham | John Roesink | Critical components controlling reservoirs |
| Peter Robinson | Kari Wright | Osteological criteria for identifying foot bones |
| Peter Sauer | Brian Ness | Paleo-environmental reconstructions based on stable isotopes |
| Anne Sheehan | Jennifer Evetts | Wyoming deep probe seismic experiment |
| Henrietta M. Smith | Erin Marsh | X-ray diffraction studies of garnet crystal structure |
| Hartmut Spetzler | Tyler Masters | Understanding the role of a meniscus in the flow of undersaturated media |
| Chuck Stern | Matt Peebles | Preparing thin sections and chemical analysis of local rocks for Geol 4710 field course |
| Chuck Stern | Steve Quane | Two buttes-mapping, collecting, selection of samples |
| Paul Weimer | Ryan Crow | Gulf of Mexico Industrial Consortia |
| Roberta Yuhas | Heather Sickels | Landscape response to Holocene climate change |

## New Faces in the Front Office

As everyone knows, the mood of the Department is greatly influenced by how smoothly the front office completes its important supporting role. Over the years Geological Sciences has benefited from a number of committed and capable individuals who often made the difference between a successful program and mayhem. The front office continues to be the central clearing house for all departmental activities; it is the one place that impacts everyone on a daily basis.

In recent years there has been a major turnover in the front office personnel due to retirements and raids from other units on campus. After a period of flux, we are back into a routine with a new, energetic and committed support staff. Beth Hanson continues as the primary liaison between the Chair and the rest of the University. Her official title is "Assistant to the Dean, on assignment to Geological Sciences". In this capacity she interacts regularly with similarly titled staff in other campus units, building a network of support personnel that benefits our program. Other positions have turned over in the last year. Our graduate secretary, Lynn Jackson, transferred to the Applied Math Department in May, 1996. Rebekah Tan, accountant, moved to California when her husband graduated in May; they just had a baby boy. Receptionist, Kathe Kelley, decided to further her education and left in October, 1996. Although we miss our former staff, we have been fortunate in securing excellent new individuals to replace them. Margaret Ahlbrandt, formerly with INSTAAR, has taken over the accounting position. At INSTAAR, Margaret gained extensive experience handling grant accounting and personnel actions and now has all of our accounts under control. Along with her myriad duties, Margaret presents the faculty with grant reports that are decipherable on a monthly basis, no small feat. Kathleen Freeman, formerly with the Atmospheric and Planetary Sciences Department, accepted the job as graduate secretary last summer. Kathy handles all graduate admissions and records, and has also assumed the job of academic scheduling, which entails scheduling courses in conjunction with the central scheduling office. Balancing faculty requests for times and rooms, with the actual rooms available, is a real juggling effort. Dave Budd and Chuck Stern helped Kathy through the transition period. Now she has to think about scheduling in the new building, a pleasant prospect for us all. Sue Long, recently arrived from Pennsylvania where she was employed by Penn State, accepted the position of receptionist late in the fall. Sue handles schedule adjustment for students (the infamous Drop/Add), as well as assisting everyone else in the office. We welcome them to the Department and commend them for outstanding performance of their duties. The office is functioning efficiently once again, and we hope to maintain status quo for a long time!

*Kathe Kelley at her retirement party.*

*Office staff (l to r): Barbara Huntting, Kathy Freeman, Beth Hanson, Sue Long, with Margaret Ahlbrandt in front.*

## What's New in the Earth Sciences Library?

Academic libraries across the country, under continuing budgetary constraints, have been focusing much of their funding on providing electronic access to information, not on building collections physically located in the library. This can be in the form of access to citations to articles that then need to be requested on interlibrary loan if the library does not own the material or access to full text versions of the article on the Internet. While availability of full text is still rare in the earth sciences, it is definitely on the horizon. AGU, for example has recently begun publishing an electronic journal that is only available in that format, not paper.

Electronic access to information in the University Libraries at CU-Boulder is exploding. In addition to the databases we have on CD-ROM in the Earth Sciences Library, we also have access to over 60 databases on the CU Libraries' online system, Chinook. Some databases ar bibliographic citations only, some include abstracts, and some are full text. These databases cover resources from the humanities and social sciences to science, engineering and technology. The increasingly interdisciplinary focus of the earth sciences sends students looking for information in areas traditionally not part of the earth sciences and access to this wide array of indexes is critical.

At the CU Libraries we have been quite fortunate to have escaped the budget slashing that has occurted recently in many academic libraries throughout the country. We continue to add a few new journals in the earth sciences each year and have not had to cancel any for budgetary reasons. Even so, we cannot support all the diverse research and teaching needs for our faculty and students on site. To that end we offer free interlibrary loan for material we do not own. A student or faculty member can generate and interlibrary loan requests directly from their home or office

*continued on page 13*

# Emeritus Faculty News

Several of the recently retired faculty are seen around Boulder and come to some of the department affairs. From these encounters, we can file this report.

**Bill Braddock** continues to teach the computer course to upper-division students. Being one of the more computer-challenged old-timers, he is converting much of his Front Range mapping to a digitized format.

**Bill Bradley** continues to present geological rafting trips, mainly with Audrey Benedict, into the canyonlands. He also gives the periodic talk to various groups in Rocky Mountain National Park. He and Louise are active in "Meals on Wheels," and they do such a good job that some of the other retirees are going to sign on.

**Jack Edwards** operates out of his office in the basement, continues to update his analysis on the future of global energy (should be out this year in the AAPG Bulletin), and enthusiastically teaches (for free) the upper-division course on mineral resources, world affairs, and the environment.

**Don Eicher** is in the department every spring, teaching either introductory field or introductory geology (second semester) or both. Don has taken up both biking and cross-country skiing, when not busy with a wide variety of geology fieldwork.

**Ed Larson** visits the department about once a week to see how we are doing, and continues work on volcanic ashes and rocks. He has a new car, is hooked up to e-mail and the internet, still runs 6 days a week, bought sidecut skis and will take advantage of his age to get deals at the ski areas.

**Jim Munoz** continues to work with his photography, stopped in to give a lecture to the mineralogy class (Joe Smyth was on sabbatical and Jeff Swope taught the class), and offers his services as a security guard during E-Town performances at the downtown theater. He told us about meeting Jimmy Carter at a recent performance. You will recognize Jim by his dark glasses, leather jacket, and billy club!

**Ted Walker** spent last winter relearning his PhD language (German), and

*continued next page*

*Ted Walker and Bill Bradley display their voodoo heads, presented at a ceremony during the Rio Grande fieldtrip, spring '79 (photo by Vance Holliday).*

# EMARC

EMARC had a banner year in 1996!

First, the BAHA exploration well was drilled in the Perdido foldbelt in the northwestern deep Gulf of Mexico. The location of the drilling site was based upon the results of a 2-year industrial consortium conducted by EMARC (Bruce Trudgill, Carl Fiduk, Mark Rowan, Paul Weimer). This well was drilled in 7,612 feet of water, making it the deepest water that an exploration well has ever been drilled in. Drilling began on April 14 and was plugged and the well abandoned on June 27, after drilling 3,596 feet below the surface. Mechanical problems caused the well to be abandoned before reaching the deeper, prospective targets. This winter, the four companies (Shell, Texaco, Amoco, Mobil) collected 3-D seismic data across part of the foldbelt to fulfill their lease requirements; they are planning to drill another well in the prospect within the next two years. Carl Fiduk won best paper at the AAPG–Gulf Coast meeting for his paper on the salt systems surrounding the foldbelt. CU's participation in this project was featured prominently in the June 1996 AAPG *Explorer*.

Second, in September, the AAPG and SEG published their new atlas entitled *Applications of 3-D seismic Data to Exploration and Development*, co-edited by Paul Weimer and Tom Davis from the Colorado School of Mines (see photo). Publication of the atlas proved to be timely, as the first edition sold out in three months, and they are now in a second printing. The atlas was featured in the January 1997 AAPG *Explorer* and dubbed a "classic" by AAPG Headquarters. The atlas is the fastest selling volume by AAPG since Memoir 26 in 1977.

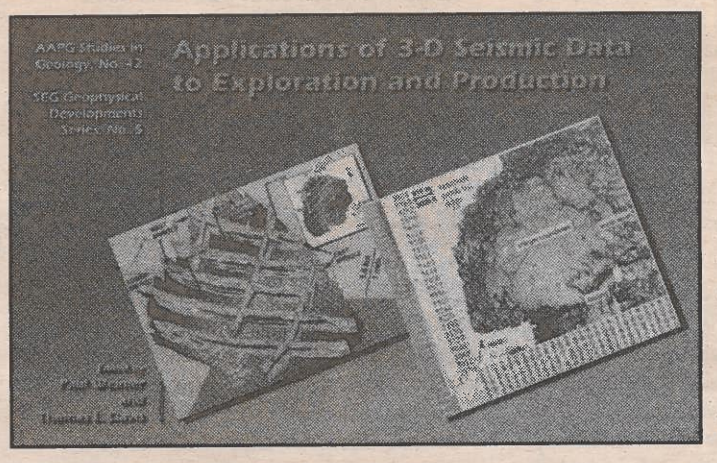
Third, the first major Gulf of Mexico research consortium was wrapped up in late May. Seventy people representing 27 companies attended the last meeting of this particular consortium. This was the first major consortium that was organized by EMARC, beginning in 1992. Eight MS degrees and two PhD degrees were or will be awarded based on the research results of this consortium. Three research scientists were also involved with the project. The final results of the consortium will be published later this year in the *AAPG Bulletin*.

Fourth, the first research project in our new reservoir sedimentology program is going full speed (Andrea Pulham, PI). This project studies the reservoirs of the giant Cusiana and Cupiagua Fields in Colombia, two discoveries that were made in the past six years. This project is focused on the evaluation of which reservoir fabrics are important in controlling reservoir performance. Our project will focus on reservoir parameters will be best to predict production performance. Andy Pulham received the SEPM Best Paper Award at the 1996 AAPG/SEPM Convention for his presentation on this research. The project will continue for 1997.

Fifth, two new research consortia were started. The first consortium is a follow-up to the first Gulf of Mexico consortium and focuses on salt/sediment interaction. One aspect will investigate the deformation histories of various types of salt systems and their relationships to synkinematic sedimentation. The other aspect will look at the sequence stratigraphy of the area using 3-D seismic data and biostratigraphy. Twenty-five companies are expected to support this project. The first review meeting will be held here in late May.

Our new reservoir consortium focuses on the stratigraphic controls of reservoir compartmentalization in marginal marine siliciclastic reservoirs (Andrea Pulham, Paul Weimer, Mary Kraus, David Budd). We are collaborating with George Pemberton from the University of Alberta. We will focus on the influence of key stratigraphic surfaces in reservoirs and how these compartmentalize and affect reservoir performance. We have chosen six fields from the North Sea, US and Canadian Rockies, and northern South America for the first year of work. After that, we plan to expand into a more global distribution of reservoirs. We expect at least 15 oil companies to support us during the first year, and more companies to join during years 2 and 3.

See *Tailings* on page 15 for more EMARC photos.



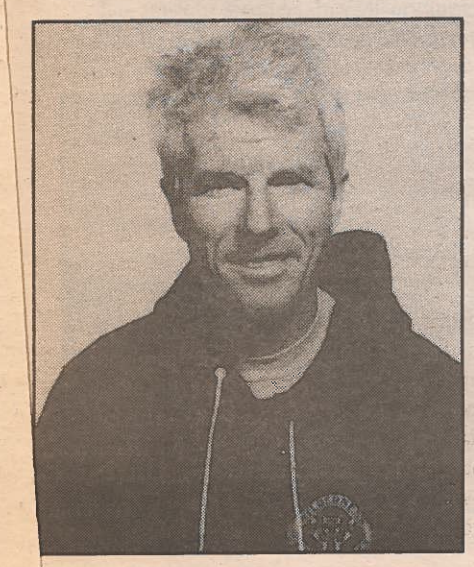

*3–D atlas cover*

# Retirement

## The Passing of an Era—The Department Peters Out

It is with a heavy heart that we inform you that Dr. Peter W. Birkeland retires from full-time status at the end of the spring semester, 1997. This occurrence marks the changing of the Old Guard. Pete represents the last prof of the group that joined the Department in the 50s and 60s. To become part of the Department in 1967, Pete left a tenure-track position in soils at the University of California, Berkeley, a position he had held for six years subsequent to his graduation (expulsion?) from Stanford University. At Stanford, he was an Indian, at UC, a golden bear, and at CU, a buffalo. All three are either endangered or extinct; in spring, so too will be Pete.

Because of Pete's previous six-year academic stint at UC, he joined the faculty as an associate professor, at a starting salary of $10,000. How times have changed. Pete's ability to perform excellent research on a shoestring budget has become a hallmark trait. Needless to say, his graduate students also learned research frugality at the feet of the master.



*Peter Birkeland*

Peter has taught a plethora of courses during his 30 years on the faculty. Year after year, he contributed to the Department's introductory physical-geology course load. No student was ever the same after taking one of his courses. Surprisingly, he became friends with many of the students. Additionally, he taught graduate courses in soils and Quaternary stratigraphy, and participated in seminars on the geologic development of the western US, including the Rio Grande rift and southwest Colorado. Recently, he has been involved in teaching field methods to sophomores, juniors, and seniors.

Pete has dabbled in a wide range of research topics over the years, including soils (from just about everywhere), Quaternary surficial processes and deposits (including rock glaciers), and neotectonism. Its difficult to associate the term "neo" and Pete, but that's the way of modern research. You take an old duffer who does soils, let him excavate a pit across an active fault, and voila!, he's a neotectonicist. The only trouble this makes for Pete is trying to spell it.

Over the years, Pete has achieved various degrees of acclaim for several of his accomplishments. For some people, cleanliness is next to godliness. For Pete, neatness is next to impossible. Althought his office appears to be complete chaos (especially these days), he can always locate crucial items (his bike, an upcoming mid-term, his wife), if necessary, in two to three days. Pete, in true academic collegiality, has been mentoring John Drexler in the way to keep a tidy office. John, to his credit, has been an apt student. Pete is also the mentor of Shemin Ge, a hydrologist hired about three years ago, but her office (former Runnells' office) is quite neat.

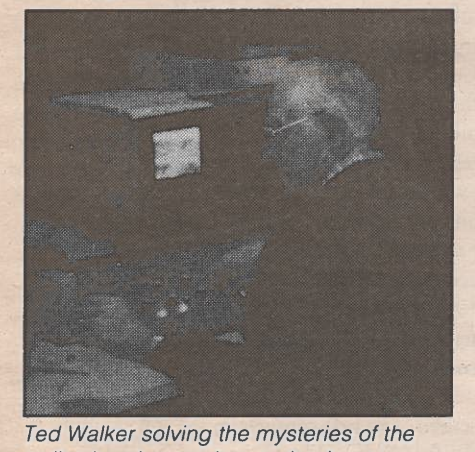
One of Pete's notable accomplishments was the initiation of the "soil-circle" tradition. The soil circle was practiced by Pete and his students on nearly all field trips. It was a spontaneous demonstration, but only occurred late in the evening after sufficient amounts of body-numbing medicinals had been imbibed. Ever-astute Pete reasoned that one person, operating only from brain-stem functions, could not remain standing for long. If, however, all of the participants in revelry formed a circle consisting of standing individuals with their arms interlocked, then no one person could fall down. Hence, the soil-circle was initiated, and to this day, it is one of the Department's most noteworthy achievements.

Among his accomplishments is being a book author, two times over. He coauthored with Ed Larson a classic introductory physical geology text (Putnam's *Geology*) and perservered through three editions. Pete wangled a shrewd business deal on this book such that Mrs. Putnam got 2/3 of the royalties, while he and Ed Larson each got 1/6. At the time of his retirement, Pete will have earned $2.67 per hour for the time spent in writing the text. Oh well, its not the fortune, but the fame. Pete also wrote *Soils and Geomorphology* (Oxford University Press) which received wide acclaim and for a while it was rumored that it would be made into a movie

*continued on page 12*

## Emeritus Faculty, cont.

then biked with Barbara in Germany and Austria during the summer. Unfortunately, there was a lot of rain. He regained his interest in the origin of the local redbeds, so is back to studying thin sections, and we see him using the SEM (see photo).



*Ted Walker solving the mysteries of the redbeds using modern technology.*

**Mark Meier** received the Horton Medal from AGU. Here is the citation from Garry Clarke of University of British Columbia, Vancouver.

The Horton Medal is awarded in recognition of "outstanding contributions to the geophysical aspects of hydrology." For the first time this medal will be presented to a hydrologist who has concentrated his attention on water in its solid phase. Mark F. Meier's long and distinguished career in glaciology spans most of the modern era for that science and he himself has played a central role in leading glaciology from its historical domain as a self-marginalized hobby of amateurs and adventurers to its present status as a fully mature geophysical science. Mark has helped steer glaciology to this high ground both by the example of his science and by his outstanding leadership of key scientific organizations.

Like many who share the blessing of an Iowa birthplace, Mark acquired a profound love for the mountains and the sea. Important figures in his early scientific development were his father, a professor of psychology and geology enthusiast; Robert Sharp, supervisor of his Caltech doctorate on glacier flow mechanics; Friedl Hoinkes, an Austrian expert on glacier energy and mass balance measurements; and Luna Leopold, who invited Mark to found a glaciological research program within the Water Resources Division of USGS.

Mark took up this offer and in 1956 was appointed Chief of the USGS Project Office - Glaciology in Tacoma, Washington. As a glaciologist working within the Water Resources Division, he was quick to grasp the Cartesian dualism that described his situation: glaciers melt, therefore they are a water resource. During his 30-year tenure as Project Chief he assembled a remarkably talented and heterogeneous group to conduct fundamental research on the hydrological aspects of glaciers and snow. Accomplishments of Mark and his Tacoma colleagues include the establishment of a rational framework for mass and water-balance data collection and demonstrations of the value of such measurements in monitoring climate change. Traditionally, mass balance studies have been seen as necessary but mundane. By a combination of rigor and high mindedness, Mark has played a unique role in rehabilitating this area of glaciology, first by clearly articulating why such measurements should be taken and second by demonstrating how such a measurement program should be conducted.

Among scientists concerned with glaciers, Mark has been the one most prominent in relating glacier processes to wider concerns in hydrology and environmental science. In his later years at USGS he expanded his research on the mass balance of mountain glaciers to address the question of how glaciers affect global sea level. His 1984 *Science* paper on this topic is vintage Meier. It gives motivation and honorable purpose to an area of glaciology that is sometimes disparaged; it steadfastly focuses on the big picture; it links the comparatively small scale and small issues of glacier processes and responses to the giant scale of the Earth system and urgent issues of global change.

Perhaps the most memorable work to emerge from the USGS years came from Mark's enormously fruitful collaborations with Austin Post. Together they highlighted the importance of fast glacier flow and glacier flow instabilities. Their classic 1969 paper entitled "What are glacier surges?" presented such a definitive description of the phenomenon of surging and a clear statement of the associated challenges to science that it has served as a virtual battle plan for all subsequent research on that subject.

The culmination of Mark's years with the USGS was the Columbia Glacier Project. Pursuing their interests in flow instability, Meier and Post drew attention to a potential instability associated with flotation and rapid disintegration of tidewater glaciers and pointed to a likely candidate, Columbia Glacier, on the Alaska Coast. Furthermore, they noted that the present state of the glacier was near the trigger threshold and warned that rapid disintegration and catastrophic retreat of the lower Columbia Glacier would disgorge icebergs into Prince William Sound, the now famous maritime route followed by such vessels as the Exxon Valdez. As Chief of the Project Office-Glaciology, Mark was able to convince his USGS superiors of the scientific interest and possible danger of this unusual environmental hazard. In doing so, he succeeded in launching what was unquestionably the first and only example of "big science" applied to a non-polar ice mass. I doubt if anyone else could have formulated the science plan or marshaled the resources that brought the project to life. Now, however, the pressure was really on. If the instability failed to develop, a deeply embarrassing situation would present itself. Nature is rarely cooperative when scientific reputations are at stake, but Columbia Glacier proved the exception; the glacier began its catastrophic retreat on schedule, and the retreat itself spawned excellent science on iceberg calving and the subglacial hydrology of fast-flowing glaciers.

Like his research contributions, Mark's leadership and service contributions are so numerous and wide-ranging that they can only be touched upon. A consistent thread is that Mark never accepts a job without leaving his imprint. It is not the status that attracts him but the opportunity of using the instruments of leadership to achieve a worthy objective. As President of the International Commission on Snow and Ice (ICSI) during the International Hydrological Decade, he seized the opportunity to promote glaciology as a hydrological science by launching the international Combined Heat-, Ice- and Water-balances Program, the World Glacier Inventory Program, and the Permanent Service on the Fluctuations of Glaciers. As the first glaciologist to become President of the International Association of Hydrological Sciences, he worked to improve the integration of ICSI within the Association and to enhance the visibility and acceptance of hydrology within the geophysical sciences. In 1985 Mark left the USGS to become Director of the Institute of Arctic and Alpine Research at the University of Colorado at Boulder. In that capacity he molded the Institute into a thriving endeavor with greatly increased financial support and a high international reputation. As a member of the first US national committee to define a geosphere-biosphere program, he participated in shaping the national and international Global Change Program and led the development of an arctic global change program.

Mark Meier's colleagues regard him as a kind of navigator for the science of glaciology because he has always been able to locate the high road and lead others toward it. We speak of him as the "Wise Man of Glaciology" (interestingly, not the Wise Old Man, because none of us think of him as anything but an active scientist). His gift for enunciating clear and compelling paradigms has helped make him one of the most influential glaciologists of our time. His enduring legacy is to have shaped the future of a science. By leadership and example, he has encouraged glaciology to shed its parochialism and raise its stature as a geophysical science. In doing so he has helped the scientific community appreciate that glaciology is a key component of the hydrological sciences and that the cryosphere is an important wild card in any discussion of global change. Mark, there is no glaciologist more deserving of the Horton Medal. Your colleagues celebrate this achievement with you.

## Retirement, cont.

(called *Soiled Dove*, starring Clay Evans and Bevis and Butthead).

Pete's crowning academic achievement came in 1988 when he received the Kirk Bryan Award from the Geological Society of America for his book *Soils and Geomorphology*. This came ten years after he received the first and only "Herb O'Brien Award" from the friends of the Soil Circle.

Pete, it's been a wonderful 30 years in the Department. It's been a privilege for us to associate with you. The Department will be less when you hang it up. Many of your colleagues think that the reason you are retiring now is so you won't have to move all of your stuff into the new building. As if you could find the stuff in your office! Also, some of the more outspoken ones in the Department have hinted that it's time for retirement because Pete, the master soilsman, has feet of clay. But they were inconclusive about whether it was illite, kaolinite, smectite, or mixed layer.

Adios, amigo. Vaya con Dios.

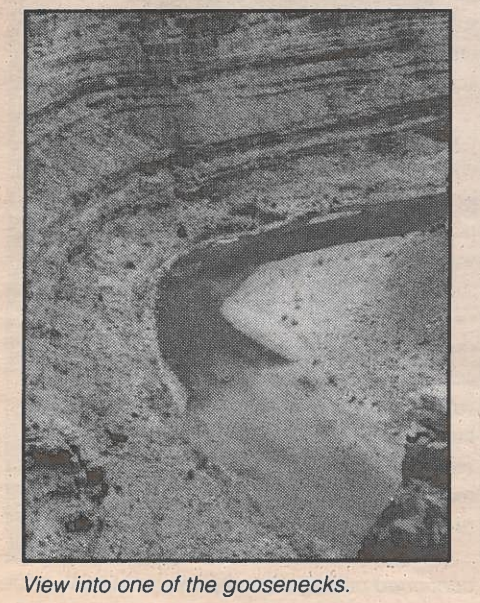
# Geology Club Spring Break Raft Trip on the San Juan River

The Geology Club ran a seven-day field trip by raft on the San Juan river from Bluff to Clay Hills Crossing, Utah, during Spring Break, 1996. The flotilla consisted of a paddle raft, two oar rafts and two kayaks. The trip was led and organized by Professor Joe Smyth. Participants included undergraduate and graduate students, postdoc and CU ultimate frisbee coach Carl Fiduk and alumnus Joe Rosenbaum (USGS).

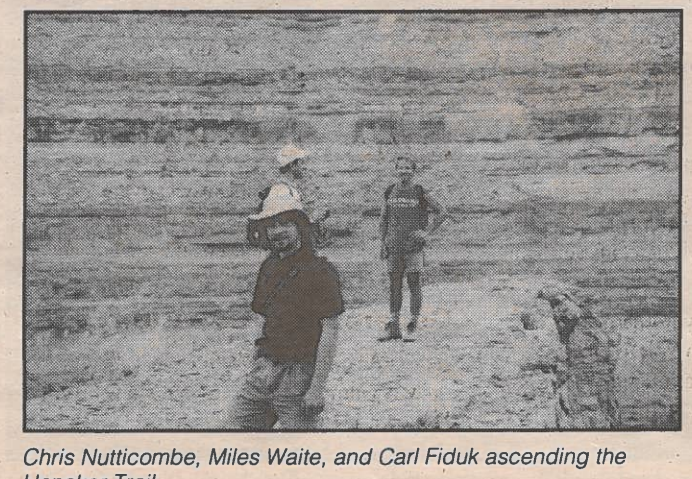
The San Juan River traverses two broad anticlines in this 83-mile section, offering a good view of the Paleozoic and Mesozoic sections in deep canyons with entrenched meanders and some challenging, but not too difficult, rapids. On the first day the group stopped to see an interesting Anasazi ruin at River House. On the second day a three-mile hike took them to Mule Ear diatreme, where a kimberlite intruded along the flexure of the Comb Ridge Monocline. After crossing Comb Ridge Monocline, the river enters its first major canyon, exposing upper-Paleozoic sediments. From the camp at Eight-Foot Rapid the group saw that the river had cut through one of its entrenched meanders, with the former channel forming a prominent side canyon. A short hike was made up the side canyon to see numerous flood deposits.

Below Eight-Foot Rapid, the rocks dip westward again. Below Mexican Hat the river enters the famous "Goosenecks" section of meanders entrenched into the Paleozoic sediments. The group hiked the famous Honaker Trail to the canyon rim, where they could see the towers of Monument Valley in the distance. The trail traverses multiple carbonate-shale onlap-offlap sequences and offers a spectacular view of the river in a canyon. The camp at Slickhorn Gulch was dampened by a brief shower, which most participants survived. The final camp at Oljeto Wash was highlighted by a moonlight walk up the narrow slot canyon.

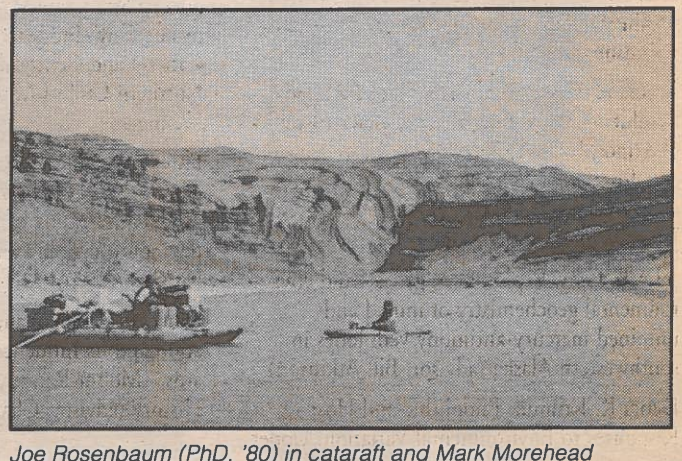
In addition to seeing some of the diverse and spectacular geology of southeast Utah, the trip also allowed undergraduates to interact informally with graduate students and professional geologists in an informal setting.



*View into one of the goosenecks.*



*Chris Nutticombe, Miles Waite, and Carl Fiduk ascending the Honaker Trail.*



*Joe Rosenbaum (PhD, '80) in cataraft and Mark Morehead in kayak.*

# STUDENT NEWS

## Student Awards

### Zena H. Andrews Fellowships

(to support outstanding women doctoral students in geology): Jorunn Hardardottir and Jennifer Mangan

Jorunn Hardardottir is a native of Iceland and is here studying for her PhD Her dissertation is on the nature of lake sediments in SW and W Iceland and evidence for climate change. Her study is a multi-parameter one with an emphasis on rock magnetic and sediment physical properties.

Jennifer Mangan received her MS degree from Penn State University working with Eric Barren on modeling early Tertiary global climate using the NCAR climate models, with the continents reconfigured in accordance with the best plate tectonic reconstructions. Since arriving at CU this fall, she and Gifford Miller have been collaborating with NCAR climate modelers to test the impact that a dramatic change in vegetation cover across Australia might have on the summer monsoon there. A simulation for a "forested" Australia 10,000 years ago, a time when globally monsoon circulation was most intense, has been completed and is being evaluated. It will be compared to a "desert" Australia simulation at the same time period to test whether vegetation alone can significantly enhance penetration of monsoon moisture into Australia. Human activities may have altered the vegetation of Australia considerably, beginning with the first aboriginal immigration 60,000 years ago. Jennifer will incorporate these studies, and modeling vegetation sensitivity to projected greenhouse warming across the High Plains of central US for her PhD dissertation.

### Association of Women Geoscientists Awards

(recognizes excellence in academics): Kimberley Langston (top female undergraduate), Sarah Brown (MS), and Roberta Yuhas (PhD)

Kim is a senior who will be graduating in May, 1997. She started at CU as an engineering major, but in the fall of 1994 switched to Geology. She has followed the Environmental Geosciences option towards her degree requirements. This means she has included topics like Hydrogeology and Remote Sensing, and the Environmental Field Geochemistry courses in her course work. At the same time though, she has also completed nearly all the courses of in the Department's more traditional Geology option. Kim played a crucial role in the recent revitalization of the undergraduate geology club and has distinguished herself throughout her tenure in the department as a student leader. Kim has been working as a part-time geologist for Bureau or Reclamation, and will be going full-time soon.

Sarah Brown is preparing her thesis defense as we go to the press. Her research is on Bench-scale Evaluation of In-situ Soil Amendments for the remediation of smelter contaminated soils from Trail B.C. By amending the soil with phosphate, Sarah hopes to reduce lead bioavailability and determine the long-term effects of the amendment under natural soil conditions. She amended lead contaminated soils with different forms and concentrations of phosphate (with the rationale being that low-solubility lead phosphates would form). She then monitored them for 9 months in a simulated natural soil environment.

Roberta Yuhas joined the Department in 1988 and worked for Hartmut Spetzler for two years before joining up with Alex Goetz in CSES. Roberta is now finishing a mammoth project studying the stabilized Holocene dune systems in northeastern Colorado, determining the chronology, sources of sand and modeling their potential for reactivation. Roberta has used all the laboratory and remote sensing tools available and integrated the information into a GIS. She will graduate this summer.

### Elaine Bass Parkison Memorial Scholarship

(recognizes outstanding women at any level): Sara Alonso-Martinez (PhD)

Sara comes from Barcelona, Spain and has been in the Department since 1994. She is pursuing her PhD studies in economic geology, working on using the spectral reflectance of illite to determine the temperature of formation with Alex Goetz in CSES. She has been doing field work in northern Mexico with Bill Atkinson.

### Bruce F. Curtis Scholarship

(scholarships to graduate students in energy resources, environmental geology, and engineering geology): Jennifer Crews (MS)

Jennifer Crews is studying the high resolution biostratigraphy of Plio-Pleistocene intraslope sediments, northern Gulf of Mexico. The purpose of her research is to use various statistical approaches in evaluating the biostratigraphy to help recognize stratigraphic cycles in these basins. This study will help refine our understanding of the sedimentary processes that occur in these basins and in making reservoir prediction in the turbidite systems.

### Estwing Award

(top Junior): Aaron Shoolroy

Aaron is from Reno Nevada and has always been interested in the mountains and the desert where he grew up. A Geophysics major, Aaron has maintained an impressive GPA. He is interested in pursuing a career in geophysics and plans on going to grad school. Aaron also likes snow skiing, mountain biking and mountaineering.

### Johnston Scholarship

(top Senior): Noah Hughes (see story about him on page 5, *Boulder Seismic Network*)

### Keith Marks Scholarship

(outstanding undergraduate): Benjamin Burger

Ben currently works on a honors thesis with Dr. Peter Robinson at the CU Museum involving the small Eocene mammal 'Hyopsodus' from the Bridger Formation of Southwest Wyoming. This has involved the reclassification of several species, but more importantly the documentation of temporal and geographic distributions of species through the deposition of the formation, looking for evidence of speciation and migration events. This summer Ben plans to continue research in the Bridger Formation with John Alexander from the American Museum of Natural History.

### W.O. Thompson Awards

(funds to assist graduate students with their research): Steve Hasiotis (PhD), Roberta Yuhas

Steve Hasiotis has already developed a national reputation for his studies of continental trace fossils. For his PhD research, Steve is subdividing continental trace fossils and their enveloping rock into ichnofacies that can be used along with the physical attributes of the rock to better interpret depositional subenvironments in the continental realm. This research includes work in modern depositional systems and biota as well as in the stratigraphic record.

### Rocky Mountain Association of Geologists award

(top Senior): Denis Duran

Denis has maintained an impressive GPA. He is graduating this spring and plans to go on with graduate study. His main interest is in geochemistry. Denis and Kim will get married this summer.

### Waldrop Fund Award

(top Senior): Colin Craven

Colin is a senior who will graduate in December 1997. He has been working with Shemin Ge and graduate student Gordon McCurry on mapping groundwater levels of the Boulder Creek watershed near City of Boulder. Colin is looking at graduate school options after graduating.

## GSA Grant to Doner

Lisa Doner was one of 22 people who received exceptionally high merit for a research grant from the GSA. The title of her project is, "Decadel-scale proxy records of the last 3,000 years from the eastern Canadian Arctic and Iceland based on lake sediment records and palynology."

## Fred Luiszer leads national trip

On August 4, 1996, graduate student Fred Luiszer led a "MOST EXCELLENT" geology field trip for the National Speleological Society, which had their annual convention at Salida, Colorado. Fred, with the help of four other geologists, led about 135 people in three buses to geologically interesting sites around Salida. Some of the stops included Mount Princeton Hot Springs, Twin Lakes, Leadville, Garfield Mining District, Poncha Pass, and Ruby Mountain. The large group had lunch at the National Mining Museum in Leadville, which was a delight for everyone. The weather was excellent and everyone had a great time (unlike a past convention field trip when a bus was lost in a lake, or the trip in which the passengers pushed a bus out of a ditch).

## Library, cont.

computer as well as at the terminals in the Earth Sciences Library.

One can only imagine what it will be like in the new Jerry Crail Johnson Earth Sciences Library at this time next year. We will have been in the new library space for almost a year by then. Those using the Jerry Crail Johnson Earth Sciences Library will have space to sit, space to work, access to a map library on site, a state of the art electronic reference area and a beautiful view of the Flatirons out of the windows on the first floor.

If you wish to access the University Libraries' on-line system, Chinook, just use the Internet to telnet to libraries.colorado.edu. The article index databases and interlibrary loan request capabilities are available remotely only to University of Colorado-Boulder students and faculty. The book catalog, however can be accessed by anyone. The Earth Sciences Library webpage can be accessed through the University Libraries webpage at www-libraries.colorado.edu (yes it is a dash after www, not a dot). Suzanne Larsen can be contacted at (303) 492-6133 or Suzanne.Larsen@colorado.edu if you have any questions.

# Degrees Conferred in 1996

## Ph.D.

Kenneth Carpenter, Sharon Springs Member, Pierre Shale (Lower Campanian): Depositional Environment and Origin of It's Vertebrate Fauna, with a Review of North American Cretaceous Plesiosaurs (advisor: Peter Robinson)

Michael A. Celaya, Fluid Motion and the Toroidal Magnetic Field Near the Top of Earth's Liquid Outer Core (advisor: John Wahr)

Robert M. De Conto, Late Cretaceous Climate, Vegetation and Ocean Interactions: An Earth Science Approach to Modeling and Extreme Climate (advisor: Bill Hay)

Peter M. De Toledo, Locomotory Patterns within the Pleistocene Sloths (advisor: Peter Robinson)

Regina A. Figge, Reconstruction of a High Resolution Holocene and Late Glacial Record of Atmospheric Carbon Dioxide Concentration from Stable Carbon Isotopes in Peat, (Carbon Dioxide, Paleoclimatology) (advisor: James White)

John E. Gray, Exploration, genesis and environmental geochemistry of mined and unmined mercury-antimony vein lodes in southwestern Alaska (advisor: Bill Atkinson)

Debra K. Krumm, Endolithic and Host Responses to Environmental Variation: Upper Oligocene Reefs of Puerto Rico and Jamaica (advisor: Don Eicher)

Charles G. Patterson, The Electrochemistry of Ground Water, Part One: Dissolved Gases in Ground Water as Indicators of Redox Conditions; Part Two: A Field Test of Electromigration as a Method for Remediating Sulfate from Shallow Ground Water (advisor: Don Runnells)

Dilce de Fatima Rossetti, Facies Analysis and Sequence Stratigraphic Significance of the Upper Itapecuru Formation, Sao Luis Basin, Northern Brazil (advisor: Mary Kraus)

Scott W. Tinker, Reservoir-Scale Sequence Stratigraphy: McKittrick Canyon and Three-Dimensional Subsurface Examples, West Texas and New Mexico (advisor: David Budd)

Peter Varnai, Integrated 2-D and 3-D Sequence Stratigraphic Analysis of Plio-Pleistocene Turbidite Systems, Northern Green Canyon and Central Ewing Bank Areas, Northern Gulf of Mexico (advisor: Paul Weimer)

Philip L. Verplanck, Origin of a compositionally-zoned, epizonal magma body: A detailed geochemical study of the Organ Needle pluton, south-central New Mexico (advisor: Lang Farmer)

David R. Zimbelman, Hydrothermal Alteration and its Influence on Volcanic Hazards—Mount Rainier, Washington, A Case History (advisor: Charles Stern)

## Master of Sciences

Patti J. Best, Thomas A. Cooper, Eric W. Dewar, Robert L. Frodeman, Peter R. Furey, David B. Gorodetzky, Eleanor R. Griffin, Kevin S. Hutchins, Marcella M. Hutchinson, Katie Keller, Matthew E. Kirby, Judith Kreps, Karen J. Lewis, Minru Liao, Roberto Linares, John J. Moore, James T. Shiroma, Elizabeth J. Sopher, Andrew B. Stein, Brian C. Welch, Jiang Xiao

## Bachelor of Arts

### May Graduation

Bradford R. Benning, Michael C. Garioto, Elizabeth J. Harrington, John T. Kleiner, Michael Larner, Maureen E. McHugh, Christopher C. McShane, Travis Nelson, Rebecca H. Preston, Meghan C. Quinlivan, Amy B. Rosewater, John D. Russell, Christopher H. Stephenson, Derrick O. Tanner

### August Graduation

Cynthia L. Byrns, Daniel J. Chapman, Benita M. Gonzales, Peter R. Goulazian, Vinita R. Hobson, Christopher J. Lowman, Mark A. Roth

### December Graduation

Jocasta A. Champion, James A. Cosby, Andrew F. Gilmore, Karen E. Grant, Justin W. Housner, Laura D. Triplett

# Alumni News

**Claud H. Baker, Jr.,** (BA, '59) has retired from Water Resources, USGS. He is enjoying Scottish-American interests and is Clan MacDougall's midwest regional commissioner. He also helps out with Habitat for Humanity.

**Victor R. Baker** (BS, Rennselear Polytech, '67; PhD, CU, '71) is a Regents Professor and the new head of the Department of Hydrology and Water Resources, Univ. of Arizona. Vic has been very prominent in international and national geomorphological affairs and was just elected Vice-President of the GSA. Like Al Gore, he thinks he will try for the presidency in '98 (this being for the GSA). His wife, Pauline, continues to work as an early childhood education specialist at Central Arizona College, and both boys have shunned geology for engineering (attending the Univ. of Arizona).

**Ronald E. Beck** (BA, '41) has retired after 37 years with Phillips Petroleum in exploration and production, both domestic and international. He and his wife, Helen, live in the Denver area and will soon celebrate their 50th wedding anniversary.

**Scott Burns** (PhD, '80) led a GSA GeoVenture entitled "Geology of the Wine Country in Western Oregon." We are trying to find out if they got beyond the first stop!

**Jack Craig** (BA, '83) is a geophysicist for Frisco Geophysical in Frisco, Colorado. After leaving CU he earned a professional degree in geophysics at Colo. School of Mines ('86), then opened up his shop close to the slopes and has been traveling the world on various seismic and positioning data projects.

**David Ellerbroeck** (BA, CU, '85; MS (environmental science), Colo. School Mines, '89; PhD (environmental engineering/groundwater hydrology), CSM, '93) is employed by CSIRO, Australia, in water resources, working on groundwater and geochemical modeling of mine site rehabilitation. He married Marilyn Jensen in '89, and they have a brand new Aussie, Mark, born last July.

**Bruce A. Geller** (PhD, '93) is self-employed with two companies: Advanced Geologic Services (consulting), and Geoconcepts Unltd. (retail and wholesale minerals and jewelry). His work has taken him to Mexico and Chile. He also helps run the Denver office of Africa Mineral Resource Specialists.

**Fred F. Hawkins** (MS, '80) jumped into the fray about earthquake return periods in the Denver area, as well as in Colorado. Fred is in the Seismotectonic Section of the US Bureau of Reclamation (with many former and present students) and was responding to various estimates in the local press. He was quoted as suggesting a return period for a 6.5 earthquake as 400 years for all of Colorado, and a probability of one in 10,000 of one occurring in the Denver Metro area. On the home front, he and Wendy have a child, Claire, one year old.

**Vance Holliday** (BA, Univ. Texas, '72; MA, Texas Tech '77; PhD, CU, '82) is now a full professor at the Univ. of Wisconsin, Madison. He continues to work in the Southern High Plains, and wrote a lot of that work up as GSA Memoir 186. His wife, Diane, is the Assistant State Archaeologist of Wisconsin and has just completed her PhD at Wisconsin-Madison. In 1995 they took a trip out west to visit his old stomping grounds, including work at the Lindenmeier archaeological site in NE Colorado and the brew pubs of Boulder with Sue and Pete Birkeland. Vance is currently president of the American Quaternary Association and notes that it has been taken over by CU grads: Julie Brigham-Grette (PhD, '85) is secretary, Peggy Guccione (PhD, '82) is treasurer, Peter Clark (PhD, '84) is a councillor, and Darrell Kaufman is the editor of the newsletter. The GSA just announced that Vance received the Gladys W. Cole Memorial Research Award to study small playa basins in the Southern High Plains.

**Harold E. Malde** (MS, '51) was honored in a recent issue of *Nature Conservancy.* Retired from the USGS, Hal volunteers as a photographer for the organization. They have used some 300 of his photographs in their publications, and he has logged 125,772 miles to take them.

**John W. Rold** (BA, '48; MS, '50) received the John T. Galey Jr. Memorial Award for Public Service from the American Institute of Professional Geologists. The award is for John's considerable efforts to make geology understandable, meaningful, and interesting to the non-geologist.

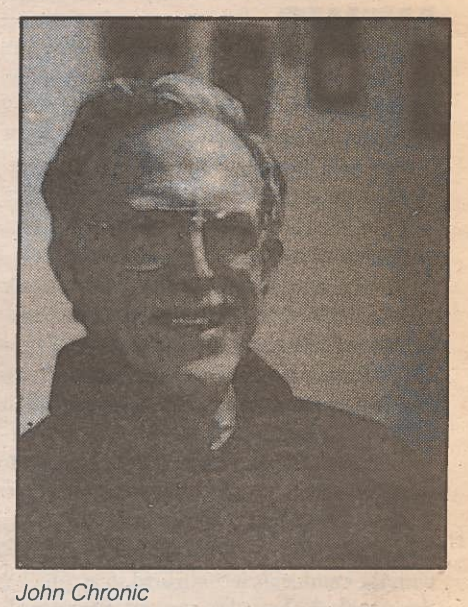
**George T. Stone** (BA, '58; PhD, '67) stopped in Boulder last summer to check out some recent books on Rocky Mountain geology. He was teaching a course from a base in Rocky Mountain National Park.

**Dederick Ward** (BA, '56; MS, '58) is a librarian turned artist, incorporating geology into his art. He lives in Washington and sent us a picture entitled "Juan de Fuca" (see photo, below).

**Lyons Whitten** (BA, '83; MS (Hydrogeology), Univ. of Massachusetts, '94) is a senior hydrologist and project manager for Coler and Colantonio, Inc., and is starting up the Amherst branch office. He and Laura have their hands full with Eliot (3) and Tommy (1). He reports that the unofficial alum meetings at the geology department at UMASS are filled with tales from Boulder.

# IN MEMORIAM

**John Chronic** passed away July 15, 1996, in Tulsa. John came to the department in 1950, after a stint on the faculty at the Univ. of Michigan (which followed completion of his PhD at Columbia Univ.). John's specialty was invertebrate paleontology. During his research career, one of his more spectacular finds was Silurian fossils in limestone that itself was embedded in a diatreme along the Colorado-Wyoming border. John was adventurous and was one of the first faculty to travel to faraway places. These included an exchange professorship at the Univ. of Edinburgh ('58-'59), a visiting professorship at the Univ. of Addis Abada, Ethiopia ('65-'66), a year of study and travel through Australia, the South Pacific, and India during a '69-'70 sabbatical, and an exchange professorship at the Univ. of Puerto Rico ('78-'79). One of the editors of the newsletter recalls a GSA float trip through the upper Grand Canyon that included some students and John, with John riding the pontoons at the head of the raft in the biggest rapids, like a bucking bronco! John retired in 1980, moved to Texas, and set up a consulting practice in Houston. We saw him last at the San Antonio GSA meeting, where he ran in the morning 10-km run. One of his more exciting trips was off to Mongolia to look for fossils. He also was a volunteer in a local museum and presented talks to classes in the local schools. His eyes began to fail in his last years, and he moved back to Tulsa, place of many old friends. John's four daughters are spread across the western US: Felicie Williams lives in Grand Junction; Emily Silver in Gardnerville, Nevada; Lucy Hinze in Cascade, Idaho; and Betsy Chronic in Fairbanks. Halka lives in Sedona, Arizona, and she and Felicie are working on another edition of *Roadside Geology of Colorado*—now in its 13th printing.

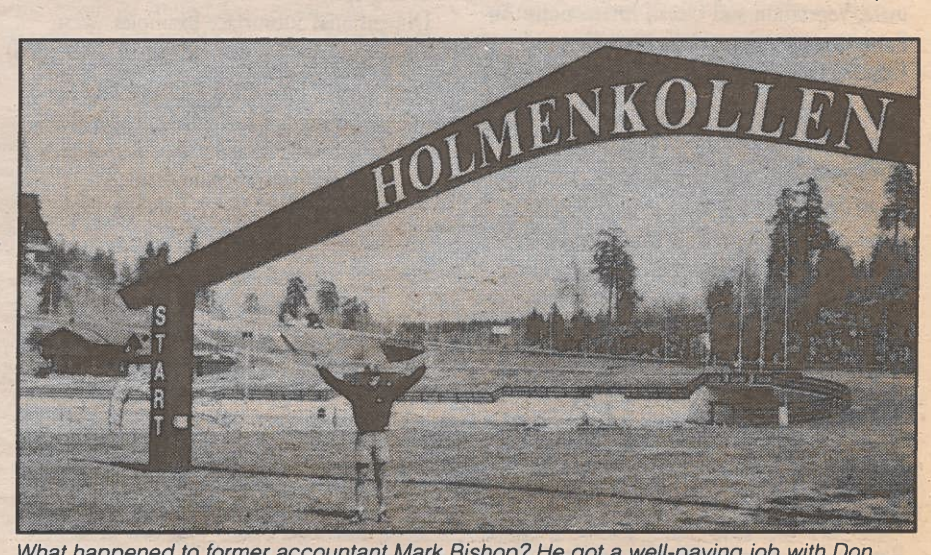


*John Chronic*

**Frank E. Williams** passed away in April 1996. He was in the department in '46-47 and received a BA degree. He went on to Stanford University and in '52 earned a MS degree in psychology. This was followed by a EdD degree in psychology from the Univ. of Utah in 1966.

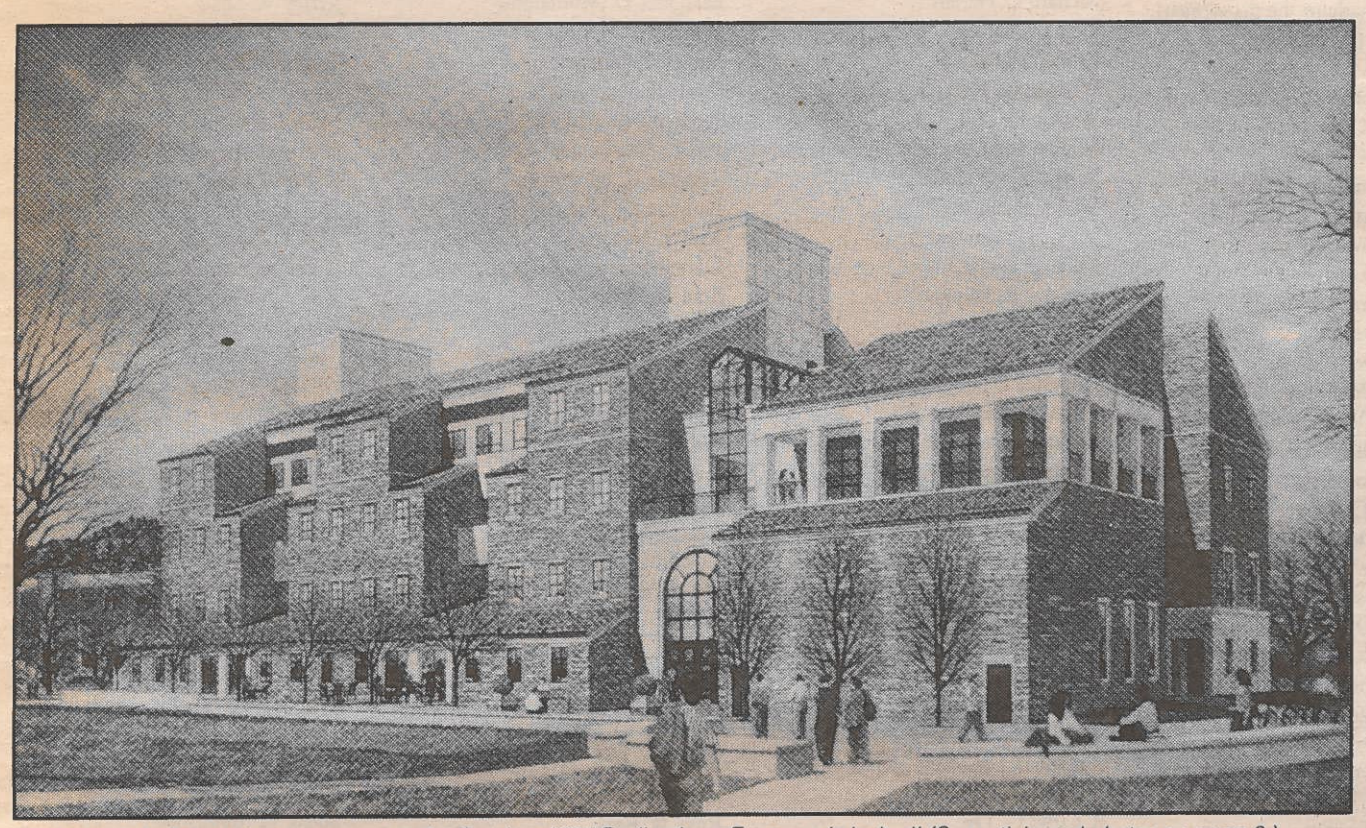
*Alum Charlie Sloan visits from Alaska and joins Ted Walker and Wes LeMasurier on the slopes of Winter Park.*

*Dede Ward's "Juan de Fuca."*

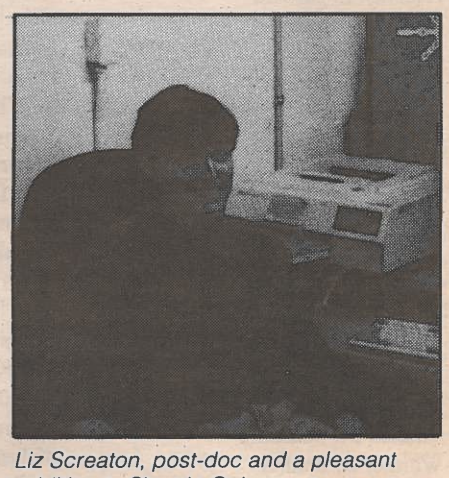



*What happened to former accountant Mark Bishop? He got a well-paying job with Don Runnells' company, well enough to go to Norway. Here he is at the start of the Holmenkollen cross-country race course.*

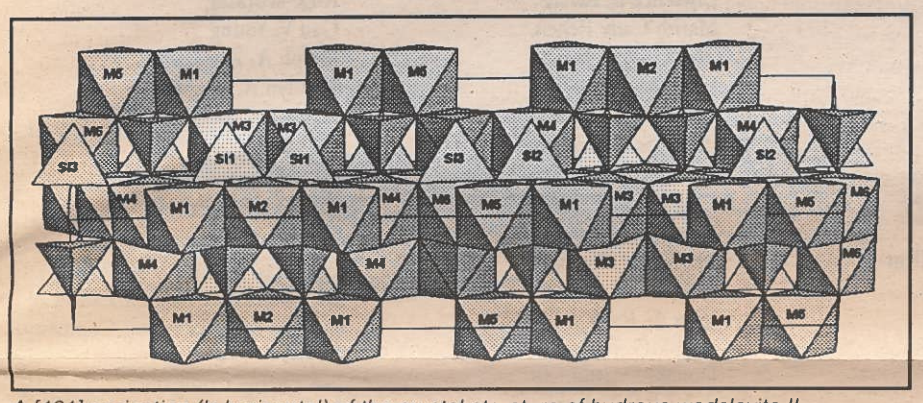
## Tailings . . .



*Look for this building when you come to the October 1997 Dedication—Everyone is invited! (See article and photos on page 6.)*

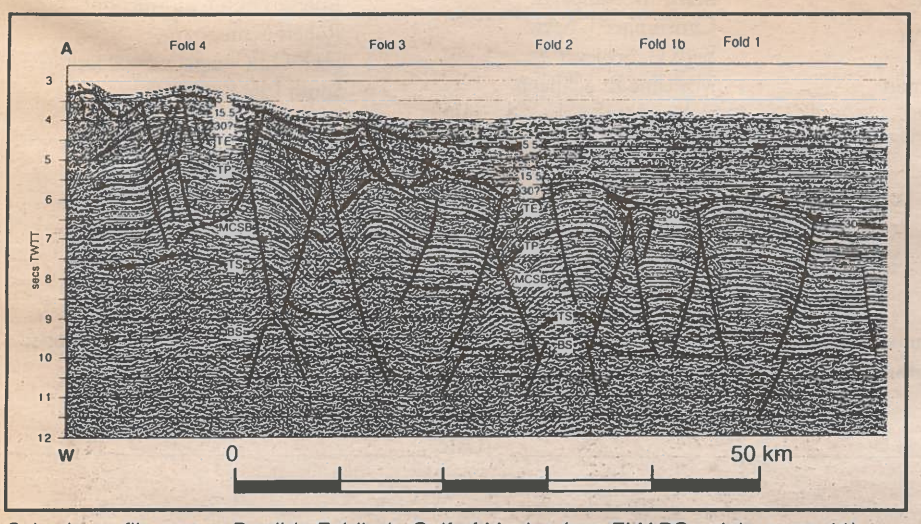


*Liz Screaton, post-doc and a pleasant addition to Shemin Ge's group.*

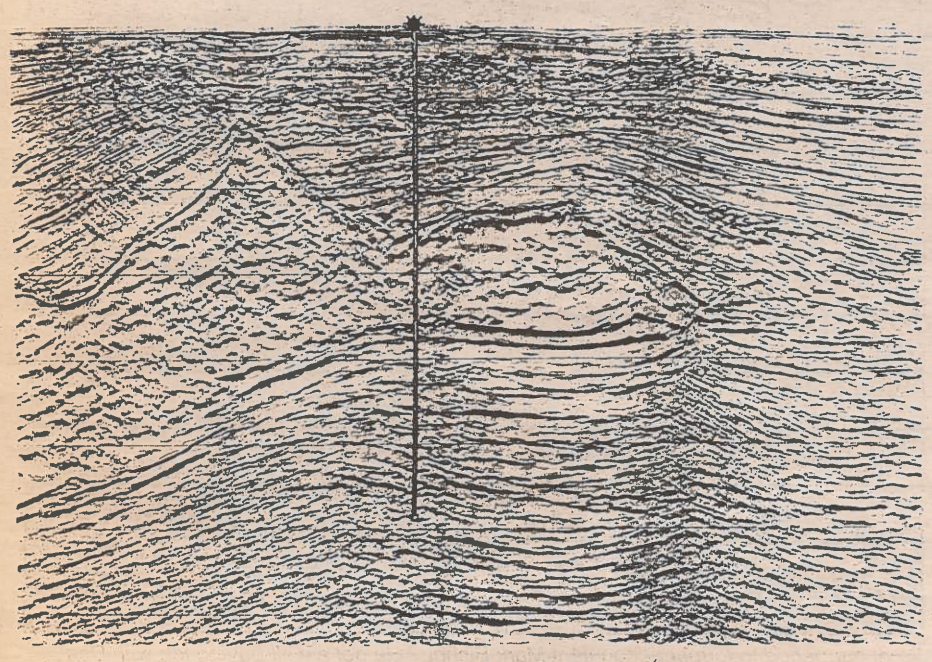



*A [101] projection (b-horizontal) of the crystal structure of hydrous wadsleyite II. Octahedral sites are M1, M2, M3, M4, M5, and M6. Tetrahedral sites are Si1, Si2, and Si3.*

*Two photos of the recent eruption of Mt. Ruapehu, New Zealand, sent by Warren Dickinson (PhD, '84). Warren took time out from his work at the Victoria University—Wellington to go skiing (see chair lift in right photo). What a blast! We hope he got a lift ticket refund.*




*Seismic profile across Perdido Foldbelt, Gulf of Mexico (see EMARC article, page 11).*



*Seismic profile showing horizontal salt tongue (middle of diagram) and the Mahogany discovery well, Gulf of Mexico (see EMARC article, page 11).*


*Cross section through a reservoir model for the Mirador Formation, Cusiana Field, Colombia. A major geological surface in the middle of the formation seems to control fluid movement and reservoir performance (see EMARC section).*

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