geophysics

Colorado School of Mines

Spring 2004

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The Department welcomes Susan Venable and Barbara Middlebrook as staff members. In addition to helping the Department at large, Susan is administrative assistant to Tom Davis and the Reservoir Characterization Project and Barbara is administrative assistant to Ken Larner, Charles Henry Green Professor.

From the Department Head

Does anybody recall that catchy lyric of the Beatles, "We get by with a little help from our friends"? From previous newsletters you are aware of the generous support we receive every year for our summer field camp with equipment donations from a myriad of companies, agencies, and organizations. Veritas and Sercel go the extra mile(s) by sending their experts along with their equipment. In the case of Veritas this means two seismic vibroseis trucks and a crew to operate and maintain them! Last summer, Roger Morin of the USGS also brought his logging truck to camp.

During the past year, among the kind donations from our alumni were two especially generous financial gifts from Jim and Arlene Payne, and Fred and Kathi Hilterman. A common thread between these two gifts is one of the giants of our past – John Hollister. Fred remembers when he was struggling to find money for equipment he needed for his graduate research, and John Hollister, the Department Head at that time, took out his checkbook and wrote a check to meet Fred's need. The Hilterman's endowment to Colorado School of Mines is aimed at equipping the department to respond to students' needs with the generous spirit of John Hollister. Jim and Arlene Payne's gift to Mines honors the memory not only of John Hollister, but also of George Meredith and Paul Keating (Geology). The Paynes' generous endowment provides for the George Meredith (undergraduate) Scholarship in Geophysics, the John Hollister Graduate Fellowship in Geophysics, and the Paul Keating Graduate Fellowship in Geology!

The highlight of our Geophysics Faculty Summer Retreat was the participation of geophysicists from other universities, agencies, and industry who enriched our discussion of the future of applied geophysics during the next 5, 10, and 20 years.

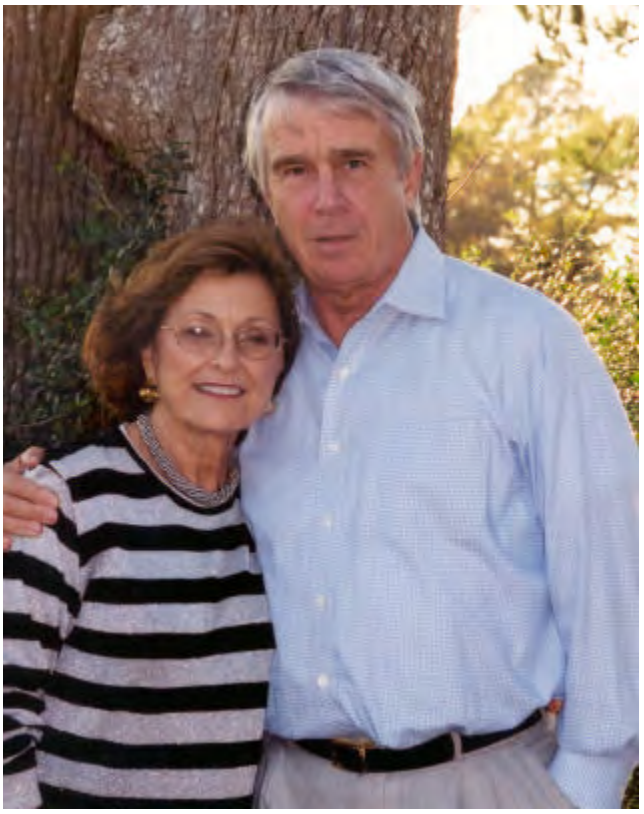
This year the Department of Geophysics is singing a revised version of the lyric—we get by with a LOT of help from our friends!

We are grateful.

Terry

Endowment Reflects Value of CSM Education

Arlene and Jim Payne (Class of '59, Geophysical Engineering) make donation to honor educators



For Jim Payne, a 1959 CSM graduate in Geophysics, three Mines professors stand out as having had an extraordinary impact on his life. Out of appreciation, Jim and his wife, Arlene have honored those professors by donating $1 million to establish the James L. and Arlene H. Payne Endowment. This gift will generate support for the following scholarships and fellowships:

- The **John C. Hollister** Graduate Fellowship in Geophysics,
- The **George Meredith** Scholarship in Geophysics, and
- The **Paul Keating** Graduate Fellowship in Geology.

Payne, who is Chairman, CEO and President of Nuevo Energy Company in Houston, states, "While I went to Colorado School of Mines, I was fortunate to be exposed to many high quality instructors and professors. As I got older, I realized that out of that group, three in particular significantly influenced my actions after Mines. I grew to understand how much they had helped me not just in my education, but in my life, and I wanted to recognize what they had done for me."

Though having vastly different demeanor and teaching styles, each of these professors was guided by a deep devotion to the welfare of their students, according to those who were their students and peers. Consequently these educators built life-long bonds between their students and themselves, and, in turn, between alumni and Colorado School of Mines.

Paul Keating's life at Mines was dominated by his teaching. He taught two of the four required undergraduate geology courses: Mineralogy and Crystallography, the latter of which earned him the nickname "Crystal Paul".

George "Doc" Meredith was a quiet man, renowned for both the rigor of his classes and his dry wit. Geophysics Professor Ken Larner recalls him as "a very thoughtful and caring individual." Professor Tom Davis states that "He gave of himself." Former student and retired professor Frank Hadsell states, "My life would have been much poorer without his tutelage."

John Hollister was a '33 graduate of Mines and served as head of the Geophysics Department from 1949 to 1972. He was a past president of the SEG, President of the Denver Geophysical Society and a winner of the Distinguished Achievement Medal of Colorado School of Mines.

Frank Hadsell, who was first a doctoral student, then a Mines faculty member during Hollister's tenure, remembers him as a people person, outgoing and a masterful networker. While department head, Hadsell recalls, Hollister earned his nickname, "Papa John", because he looked out for his faculty and students.

As noted by Tom Davis, "underlying all of their actions as professors was the understanding that Mines, as an institution, has a valuable and rich heritage." Keating, Meredith and Hollister believed that each generation of students and faculty owed much to their predecessors, and that the way to repay that debt was to pass on as much as one could to those who followed. Jim & Arlene have done just that.

Thank you to David Rein of the CSM Alumni Office who allowed us to use portions of a more detailed article that he wrote, appearing in the Spring 2004 issue of Mines Magazine.

Ken Larner Announces CSM Retirement

Ken Larner, Charles Henry Green Professor of Exploration Geophysics, has announced his retirement from Mines and the Department of Geophysics, effective September 2004.

CSM Senior Ken Larner (1960).

Ken joined the CSM Geophysics Department faculty in 1988 after an 18-year career with Western Geophysical (now WesternGeco) where he was senior research scientist and then vice president for geophysical research

During his years at Western, Ken developed a reputation among his peers as a "brilliant researcher" who made significant scientific contributions, particularly in the area of seismic imaging. Several seminal papers written during those years, for which he earned top honors, are still of significance to the exploration industry today.

The change of careers that brought Ken to the CSM Geophysics Department was a homecoming of sorts. Ken received his B.S. in geophysics from Mines in 1960. (After serving in Vietnam in the U.S. Army, he received his Ph.D. from Massachusetts Institute of Technology.)

The switch to academia was a perfect fit. Ken brought total dedication to his role as teacher and mentor, exacting high standards from his students. His efforts—though not always his lavish use of red ink—have been appreciated by hundreds of students who have benefited from his talent to convey difficult concepts in clear language, and who have left Mines with the confidence and ability to achieve their goals. Though you won't find it on his formal CV, at times through the years, Ken has been voted Mentor of the Year by his students. In addition, his loyalty and service to his alma mater earned him the 2003 Melville F. Coolbaugh Award from the CSM Alumni Association. In 1981 he was awarded the CSM Distinguished Achievement Medal.

Larner quote, recorded by a student in his Seismic Methods class, "Geophysicists know nothing."

Ken is famous for nourishing not only the minds of his students, but also their stomachs. In fact, one student goes so far as to say, "When I think about Dr. Larner, I instantly think of food." His labs and lectures often include breaks for bagels and cream cheese, or a delicious homemade dessert from his wife, Nancy.

For those who know Ken and his sense of humor, it's no surprise that he incorporates some fun into the mix of intense homework and exams. Ken and Nancy host an annual ice skating event that concludes with (you guessed it) more delicious food and hot chocolate at their home. Ken is also famous for his promotion of regular Friday pizza lunches in the Department to which he invites any geophysicist within

Ken and Nancy Larner enjoying a Colorado winter day.

distance of the aroma. The only rule—no pineapple on the pizza.

A short while after his arrival in the Geophysics Department, Ken became associated with the seismic research and consortium group, the Center for Wave Phenomena. Upon Norm Bleistein's retirement as CWP Director in 1999, Ken took on that additional responsibility. This year the group celebrates 20 years of research and graduate education.

Ken's contributions to geophysical research have been well recognized. Most recently, he was awarded the 2003 Kapitsa Gold Medal by the Russian Academy of Natural Sciences; in 1996 he received the Maurice Ewing Gold Medal from the Society of Exploration Geophysicists; in 1988 he received the Conrad Schlumberger Award from the European Association of Exploration Geophysicists. These are only a few examples recognizing Ken's continued advocacy of the geophysical industry.

Every person approaching retirement is asked their plans for the future. Ken resists any such guesswork, but it is certain he will spend a fair portion of time in the Colorado outdoors, including his and Nancy's favorite haven–their cabin in Grand Lake.

CSM Professor Ken Larner (2004).

Whatever his future occupations, he can be assured that he has left a true legacy to oncoming generations of geophysicists who are proud to have been his students.

WE HAVE SPIRIT

Yes We Do…

— John Chakalis and Monica Guerra

ConocoPhillips SPIRIT Scholars and CSM geophysics students John Chakalis and Monica Guerra.

Safety. Innovation. Responsibility. Integrity. Teamwork. ConocoPhillips created the SPIRIT Scholars Program to foster these values.

The SPIRIT Scholars Program was initiated in 1996 by Phillips 66 as the Phillips Scholar Program at the University of Oklahoma and later at Oklahoma State and the University of Tulsa. The program was designed to recruit outstanding students and provide them with leadership and public service opportunities. Students in the program receive scholarships, business-related training, and professional mentoring. In 1999, the program was implemented at CSM, and is available to students in geophysics, geology, petroleum engineering, and chemical engineering.

Upon the merger of Conoco and Phillips in 1996, ConocoPhillips continued to contribute to higher education through the ConocoPhillips SPIRIT Scholar Program. Through the program, CSM receives $150,000 in scholarship funding and in addition, undergraduates selected as SPIRIT Scholars receive a summer internship.

As part of the program during the Fall 2003 semester, ConocoPhillips sponsored a trip to their headquarters in Houston for all CSM scholars where they were introduced to various divisions of the company. The scholars experienced the excitement of "bid week" and received hands-on training with a 3-D visualization system. The trip concluded with a team-building workshop and a look into go-cart racing–an important use of a ConocoPhillips product.

Representatives from ConocoPhillips frequently visit CSM to meet with the scholars. Recent activities include cooking Thanksgiving dinner at the Ames House for adults with special needs and a holiday luncheon for the CSM scholars. The scholars at Mines are appreciative of the support they receive from ConocoPhillips through this program that provides insight into potential career fields, helping undergraduates find a focus for their academic work.

Middle School Revisited

— Sarah Shearer and Michael Ewing

The Geophysics Department, in its on-going attempt to improve student education, has sent two graduate students back to middle school. They were not sent back to sit in the classroom again, but rather Sarah Shearer and Michael Ewing were selected to teach middle school students about the wonders of science!

As part of a National Science Foundation grant awarded to CSM to put graduate students into middle school classrooms, Sarah and Mike are expanding the minds of 7th and 8th grade science students at Hodgkins Middle School in Adams County District 50. Together with classroom teachers, Chriss Kilburn and Louise Belnay, they bring excitement and knowledge to topics like energy, waves, geology, biology, chemistry, and oceanography.

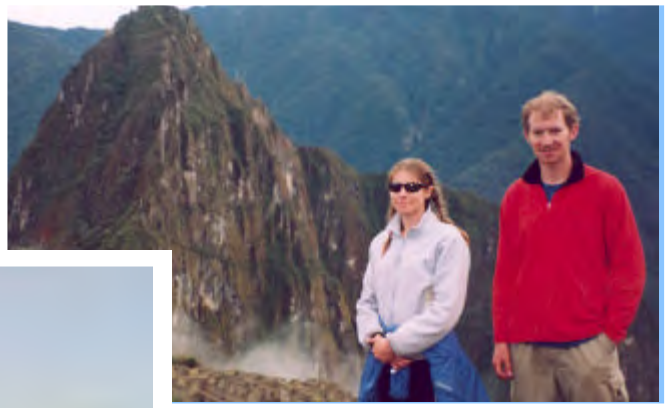
In addition to teaching, Sarah and Mike are responsible for grading, lesson planning, curriculum development, and maintaining portfolios and web pages about their experience. They also spend time outside of the classroom volunteering and organizing activities like MESA, math tutoring, Anime Club, and Web Design Club.

Sarah and Michael at Hodgkins Middle School with Chriss Kilburn (left), 7th grade science teacher and Louise Belnay, 8th grade science teacher.

This experience has provided Sarah and Mike with a lot of insight into the middle school environment and life at the front of the classroom. It is a fantastic opportunity for students considering a possible career path in education.

Work Hard Play Hard...

Our students are an active group who have achieved many feats–both academic and physical. You will find here a sampling of their interests outside of the classroom.



Lauri Burke (geophysics graduate student) and Todd McFadden (petroleum engineering alumnus) reach the lost city of Macchu Pichu after hiking four days through canyons, cloud forests, and high jungles on the Inca Trail, Peru.

Alex Grêt and wife Adrienne are in Ecuador at the summit of Cotopaxi, the world's highest active volcano (10,388 ft.). Adrienne is pictured on the front cover ice climbing on Chimborazo (20,700 ft.).

Justin Modroo is a professional skier, ranked third in North America on the Big Mountain Freeskiing Tour. He also loves fly fishing and backpacking.

– photo by Rick Gentzkow

Upside-down, Huub Douma windsurfing on IJsselmeer at Makkum in Friesland, a northern province of Holland.

Mila Adam with friends on a snow trek in the San Juan Mountains.

Department comeraderie is tested on the GP intramural soccer team (note the young recruit for class 2020).

The Department teams up for intramural volleyball. Sarah Shearer waits optimistically for the next serve.

Senior Jared Peacock, a member of the successful Mines soccer team, became the all-time leader in assists and was points leader in 2003. He also excels on the Mines indoor and outdoor track teams. He competed in the 2004 Indoor Nationals in Boston and is aiming for the 2004 Olympic trials in the 800 meter event.

Colorado was a perfect fit for cycling enthusiast and visiting Utrecht University student, Mark Vrijlandt.

Jonathan Woolley (back to camera) goes for the catch during an ultimate frisbee game. As an undergraduate, Jonathan helped organize the first Mines team.

Kasper van Wijk is at home in the mountains during any season–day or night! And GP adopted mascot Charlie (owner Kasper) tags along.

From the Kingdom of Bhutan to Golden

The Kingdom of Bhutan is an ancient kingdom secluded high in the Himalayas with unique customs and people. Adding to the diversity of the Geophysics Department, Tashi Tshering is currently a senior at CSM from Bhutan. It's a long way from Bhutan to Golden and during an interview with Professor Terry Young, Tashi shared some of his story.

Tashi Tshering comes from a Bhutanese family of six children. Traditionally, large families are thought to be a sign of prosperity in Bhutan, which is primarily agricultural. In the 1980's the government introduced family planning and began sending students to school at no cost to the families. This policy encouraged more students from villages to attend. However, from the 1990's onward, families have been expected to pay some of the costs for education, thus forcing a decrease in family size.

After high school, Tashi took a comprehensive exam that is administered throughout Bhutan and was awarded a Fulbright Scholarship. When given the option to choose a university in the United States, Tashi visited the Division of Geology and Mines in Bhutan, where he learned about the Colorado School of Mines.

Before coming to Mines, Tashi worked as a tour-company guide, which gave him opportunities to meet Westerners. A Belgian on Tashi's tour advised him to stop in Europe enroute to the U.S. to get accustomed to the occidental world. Instead he was given a ticket from Bhutan directly to Kansas. Tashi spent six weeks at the University of Kansas

Tashi's classmates in the Kingdom of Bhutan.

with other international Fulbright scholars learning computer and library skills.

Was it a big culture shock for Tashi when he arrived at Mines in Fall 2000? Though the official Bhutanese language is Dzongkha, teaching is in English–the Queen's English, not American English. Tashi learned that the differences between the two can sometimes get you into trouble. For example, there is no such thing as fast food in Bhutan, so the question "For here, or to go?" made no sense to him.

There are also diet differences between Bhutan and the U.S. Meals in Bhutan consist mostly of rice dishes, supplemented with another dish on the side; unlike in the U.S. where something like a steak is the entree, with rice on the side.

The traffic is another striking difference between Bhutan and the U.S. In Bhutan there is no need for traffic lights. There are neither many cars nor bicycles. Bhutan does have traffic police in a few intersections in the capital, prompting a tourist on Tashi's tour to ask, "Why are there policemen dancing in the middle of the road?"

Fulbright scholar Tashi is shown here on the right in traditional Bhutanese dress.

Education through high school is very good in Bhutan. Tashi arrived on campus having already taken the equivalent of Mines requirements Calc I, Calc II, Physics I, Physics II, Chem I and Chem II. So Mines classes were easy for him in the beginning. Furthermore, having taken all these courses back home in English was a real advantage for him.

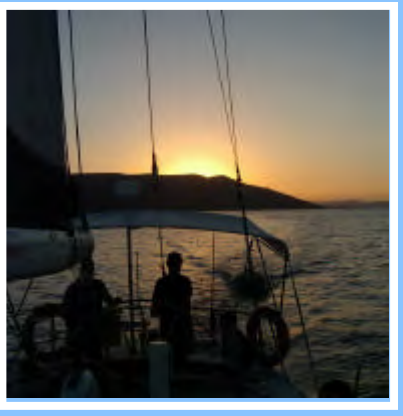
When Tashi arrived at Mines, he intended to major in geology. He didn't know about geophysics. However, he has always liked math and physics–especially analytical problems–and subsequently changed his major.

In exchange for his scholarship, Tashi expects to return to Bhutan to work. There is no oil in Bhutan, so most of the work is in environmental and mining. Potential field (geophysical) methods are important in both areas, so Tashi is taking courses in these areas and in mining geophysics, as well as trying to broaden himself by taking as many other courses as possible.

The Division of Geology and Mines in Bhutan consists of about ten people, most of whom have degrees in general geology. They don't do extensive geophysical surveys or analysis of deposits. Tashi would like to map his entire country to produce, for example, a gravity map as a quick reference for mineral exploration and mining. But he's not sure there is even a gravity meter in Bhutan.

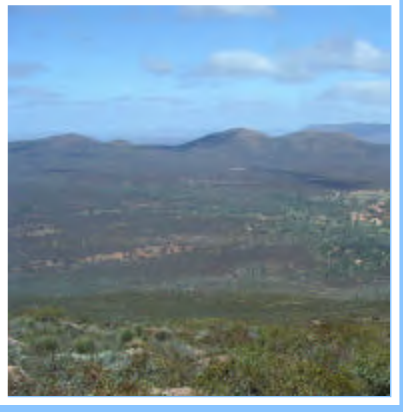
He would also like to apply geophysical methods to estimate the ultimate expected recovery from the mines in Bhutan. Every ten years the ownership of mines changes, and is open to the general public through auction. If he could provide estimates of ultimate recovery from each mine, it would increase the confidence of Bhutanese entrepreneurs to invest in those mines.

We are glad that Tashi found his way to Golden, CSM and the Department of Geophysics. We look forward to learning what is in store for his future.



A sunset in the Whitsundays near Hamilton Island

Whitehaven Beach in the Whitsunday Islands



Wilpena Pound in the Flinder's Mountains north of Adelaide

Study Abroad – "One of the Best Things"

Thomas (Dylan) Mikesell

During the Fall 2003 semester, I studied abroad in Adelaide, Australia.My decision to take this opportunity early in my college career was influenced by a Mines student from Adelaide. After hearing him talk about Australia, I had a persistent urge to see it for myself. The CSM Office of International Programs helped me find classes that would transfer, and then I was ready to go.

Upon my arrival in Sydney I found the nearest hostel, unloaded my stuff, and headed off to see the popular sights: Sydney Harbor, Harbor Bridge, Sydney Opera House, and Botanical Gardens. Then I headed to Adelaide to start my study abroad. I arrived a week before classes started so that I could attend the international student orientation consisting of class registration and trips to local sites. The next week school started. Up to this point I had as much free time as I desired, which continued for most of the semester.

I had spare time because I only took three classes and "down under" the grading is very different. The grade for each of my classes was determined by a final exam worth 80%. The lack of homework and projects that we so often find ourselves overwhelmed with at Mines left my nights and weekends open to take in the Australian atmosphere.

Weeknights were spent getting to know the locals down at the pub or just hanging out with the Aussie kids I lived with. I spent weekends rock climbing in the Adelaide hills or going to Glenelg Beach. I also tagged along on a few trips with Australian students heading home for the weekend. During a two-week "spring break" in September, I traveled with two American students who were also studying in Adelaide. We planned an expedition to the east coast and then on to central Australia. We were very lucky to get some good tips from the locals about unique and obscure places such as Noosa Beach, north of the touristy Gold Coast. I stayed on the Gold Coast for three days in a city known as Surfer's Paradise before I headed north. We stopped in at the well-known attractions: Brisbane, Airlie Beach, and Cairns.

After the east coast I headed into the "Red Centre" to experience Ayer's Rock and the rest of the Australian Outback. We also hiked the Olga Mountains and Kings Canyon.

I finally did have to do some schoolwork and I studied for a solid week before the final exams. I returned home just before Thanksgiving, after one more trip south to the "Great Ocean Road." By that time my grades had come in and the hard work of studying had paid off.

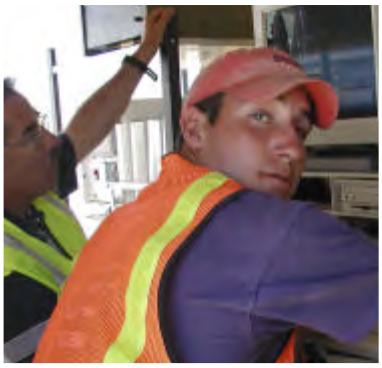
I made some wonderful new friends in Australia and had an amazing semester hanging out on the beach. My study abroad in Australia was one of the best things I have ever done. I recommend it to anyone.

Dylan MIkesell (right), Matt Gardine, and Sarah Thompson shared their study abroad experiences during a meeting of the Society of Student Geophysicists. Matt and Sarah studied at Delft University, The Netherlands, another of several English-speaking Study Abroad programs available to geophysics students.

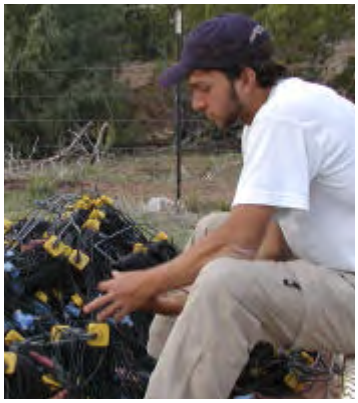
The Department encourages students to pursue the opportunity to study abroad for a semester or full year during their undergraduate years at CSM. There are several attractive options for students studying geophysics.

EXPLORING FOR WATER

Summer Field Camp Moves to Estancia Basin, New Mexico

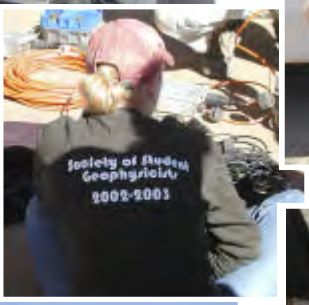


After years of conducting the Geophysics Summer Field Camp in South Park, Colorado, we tried something new last summer. In response to an invitation from the Edgewood Soil and Water Conservation District, we spent four weeks in the Estancia Basin of New Mexico applying an assortment of geophysical methods to map the local aquifer and to study its recharge dynamics. One of the big reasons we went to New Mexico was the invitation we received from Vern Wood to stay on his ranch. He provided the accommodations (tents for students), the outdoor shower (one for all 20 or so of us), and he (and his friends) butchered a cow and did all the cooking for us. Can't beat that. With warm hospitality like that, we may have to go back one more summer to make sure we did everything correctly.





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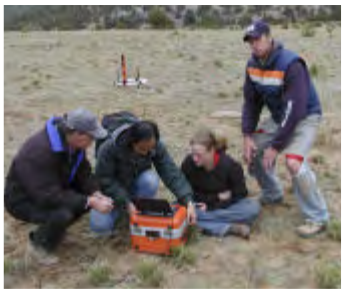
2002-2003












MAKING THE SUMMER COUNT

The Department of Geophysics helps its students find summer jobs in geophysics from freshman year onward. Here is one student's story.

Jonathan kayaking in the Port of Valdez, Alaska.

Student Internships Yield Geophysics Learning (and Fun)

— Jonathan Woolley

Five companies, seven different geographic locations, eighteen months of industry experience, and loads of fun – that pretty much sums up my past six summers working in the wonderful world of geophysics. It began on a seismic crew the summer following my freshman year at CSM, and I'd do it all again in a heartbeat. So what's the big deal? Why should every student try to take advantage of these wonderful opportunities afforded to students in the geophysics program here at CSM? I'm glad you asked!

First of all, in a world where experience can be the biggest selling point on your CV, these internships are invaluable. There is no better way to see the various aspects of the geophysical industry, and to decide for yourself where you fit in best. My personal experiences have taken me through all the various aspects of the seismic industry. I've been blessed with the opportunity to see hydrocarbon exploration first hand—from stomping geophones in the cornfields of the San Joaquin River delta to building AVO (seismic) models in the deep water Gulf of Mexico. No class can teach a student what he or she can learn first hand from working on a seismic crew or visiting a deep water drilling rig.

If you love to travel, you can't afford to pass up these opportunities. From Central California and Southern Mexico to Alaska and Texas, you can see it all. The recreation possibilities are as endless as the imagination of a geoscientist, which is often quite large. These internships gave me the chance to kayak in the Port of Valdez, hike Kodiak Island, rock climb in Northern California and New Mexico, raft through class-five whitewater, scuba dive Cozumel's reefs, and paraglide, to name just a few things. This is way off the fun-meter scale

With a crew in Tabasco, Mexico.

On the job in the Gulf of Mexico and diving in Cozumel (below).

Rock climbing in New Mexico and working on a seismic crew in California.

From sea level at Jackaloff Bay (right) into thin air at Exit Glacier, Alaska (below).

when compared to your average college summer job!

If all of the above fail to convince you that a summer job in the geophysical industry is an experience second to none, consider this next point. You get paid to do it. I've had the chance to work for Western Geophysical, Phillips, Marathon, BP, and Pioneer Natural Resources, and these are only a fraction of the companies that recruit CSM geophysics students for summer jobs.

While I believe every geophysics student at CSM can easily find a worthwhile summer job, I leave the reader with a final note of caution: with so many opportunities to pick from, choose wisely, young geophysicist.

LOOKING TO THE FUTURE

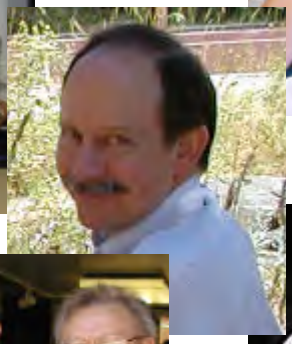
Each summer the Geophysics Faculty spends 2-3 days away from campus on a retreat during which they wrestle with strategic-level issues that don't get sufficient attention during the rush of the academic year. Last summer's retreat was a bit different. The entire time was spent on a single issue: what is the future of applied geophysics 5, 10, and 20 years from now? A large group of distinguished visitors, including the Department's visiting committee, was invited to join the faculty in considering this question. We thank those who were able to accept our invitation to participate:

Peter Annan, Sensors & Software
Craig Beasley, Schlumberger
Kevin Furlong, Penn State
Dave Hale, Landmark Graphics
Murray Hitzman, CSM (Geology)
Vic Labson, USGS
Katherine McCall, Univ. Nevada-Reno
Jim Payne, Nuevo Energy
Jamie Robertson, Rannoch Petroleum
Bob Truman, Baker Atlas
Roger Turpening, Michigan Tech
David Wald, USGS
George Wood, Sercel

Jim Payne and Bob Truman

Katherine McCall

Craig Beasley (left) and George Wood (below)



Dave Hale with graduate student Matt Haney

Adel Zhody, Vic Labson and Misac Nabighian

Max Peeters and Jamie Robertson

Front Row: Misac Nabighian, Max Peeters, Craig Beasley, Terry Young, Katherine McCall, Bob Truman, George Wood, Alex Kaufman, Yaoguo Li. Back Row: Tagir Galikeev, Peter Annan, Roel Snieder, Vic Labson, Ilya Tsvankin, Dave Hale, Jamie Robertson, Adel Zhody, Kevin Furlong, Gary Olhoeft, Matt Haney and Mike Batzle.

The Future and Applied Geophysics

So, what does the future hold for applied geophysics?

At our recent Geophysics Faculty Retreat (see preceding page), Terry Young addressed this question by presenting ten grand-challenge problems facing planet Earth (and beyond), which he believes will engage the efforts of geophysicists for decades to come:

· **Water**: providing freshwater for the 20% of Earth's population that lacks it; dealing with drought in the Western U.S.; and other water-related issues.

· **Precision Agriculture**: using geophysical techniques to assess soil characteristics (moisture, salinity) and to evaluate health of crops and effectiveness of crop treatments.

· **Energy**: discovering and developing energy resources (conventional/non-renewable and "alternative"/renewable).

· **Aging Infrastructures**: using geophysical methods for non-invasive monitoring of such things as aging bridges, roads, railroad beds, tunnels, and natural gas pipelines.

· **Geotechnical Engineering**: characterizing the subsurface in advance of engineering activities such as large-scale construction and tunneling.

· **Hazardous Waste**: guiding responsible disposal and isolation of toxic materials.

· **Geo-hazards**: mitigating the effects of volcanic eruptions, earthquakes, landslides and similar natural hazards.

· **Homeland Security**: locating, identifying, and mitigating the effects of unexploded ordnance (UXO) and landmines; exploring for tunnels and caves.

· **Climate Change**: understanding global changes in climate and the causes, and helping guide mankind's response.

· **Planetary Exploration**: exploring Mars and beyond.

Gary Olhoeft presented a list of challenging opportunities in the areas of infrastructure monitoring, geotechnical engineering and environmental geophysics.

Murray Hitzman, CSM Department Head for Geology and Geological Engineering, one of our distinguished visitors at the faculty retreat, presented his vision for geoscience curriculum reform. He proposed a multi-disciplinary, systems approach that encompasses the issues stemming from interactions among the atmosphere, biosphere, lithosphere, and hydrosphere, and even the human-sphere.

Attendees enjoyed unconstrained, “blue-sky” discussion of a broad spectrum of new developments in science and technology that are likely to influence future directions in applied geophysics. The discussion suggested geophysics will be used increasingly, not only for characterization of the subsurface, but also for quantification. The solution to important geo-problems will derive from an integrated effort of associated disciplines (such as geophysics, geology, environmental science, civil engineering). And the well-equipped geophysicist of the future will be knowledgeable in subjects such as economics, business, and public policy.

Job Outlook for Earth and Space Sciences

We've all heard of the impending, large-scale retirement of the baby boomer generation, and the anticipated significant increase in demand for graduates in geophysics and other fields. Citing a report by the American Geological Institute, the American Geophysical Union, and the American Institute of Physics, a recent article in *Physics Today* (March 2004) indicated that today’s geoscience job market is good, but is perceived as bad. Focusing on PhD’s in particular, the article gave these points, among others:

· Starting salaries ranged from less than $35,000 for academic postdocs to $75,000 for industry positions

· Among earth scientists who entered the private sector in 1999-2002, employment percentages were divided approximately as follows:

- Petroleum industry, 39%
- Nongeoscience companies, 20%
- Environmental consulting, 16%
- Weather and logistics, 5%
- Mining, 3%
- Other areas, 17%

A report entitled The Earth and Space Science PhDs, Class of 2002, is available on the Web at http://www.aip.org/statistics/trends/reports/agu02.pdf .

Abu Dhabi National Oil Company and CSM: Partners

— Robert M. Baldwin

The Petroleum Institute (PI) in Abu Dhabi is now in its third year of existence. The PI was established in 2000 in the United Arab Emirates as a cooperative venture between the Abu Dhabi National Oil Company (ADNOC) and four major international oil companies : BP/Amoco, Shell, Total, and JODCO.

The Colorado School of Mines (CSM) was selected to be the academic advisor to the PI for the development of the academic and research programs. Under a nine-year contract, CSM's major responsibilities include providing the academic leadership for the PI concerning curriculum, development of facilities and academic infrastructure, and faculty recruiting. A key component of the agreement between the PI and CSM is the goal of achieving international accreditation through the Accreditation Board for Engineering and Technology (ABET).

The physics lab, Building II (above), and (right) construction of Building III for Junior and Senior Labs, Umm Al Naar campus (November 2003). Student hostels are shown in the background. Pictured below is an attractive study area.

"To have a presence in such a rich part of the world, in relation to energy resources, is invaluable," stated CSM's Vice President of Academic Affairs Nigel Middleton, upon the announcement of the agreement in 2001, "It will increase our visibility in the energy industries and will provide enrichment for all our programs."

As of Fall 2003, the PI had approximately 400 students on campus studying engineering. Future plans are to add approximately 250 students each year, as construction allows, until the undergraduate enrollment reaches 1000. The PI is now operating from two new academic buildings, with a third specialized lab building under construction. Two more buildings – a student center and a student and faculty recreation facility are now in the final stages of design.

The PI offers five undergraduate engineering degrees including chemical, electrical, mechanical, petroleum and petroleum geosciences. Student exchange programs between the PI, CSM, and other engineering schools in the US and Europe are also being developed. Planning is underway for the initiation of graduate studies and research activities, and a new graduate and research center is in the initial stages of planning and design.

This year seven current and former CSM faculty and staff are working at the PI. Dr. John O. Golden, Professor Emeritus of Chemical Engineering and former Vice President of Academic Affairs at CSM, is in his third year as Chief Academic Officer of the PI. John's wife Lynne Golden is also working at the PI as a student counselor. Dr. Hugh Murphy is in his second year teaching physics at the PI.

Other faculty and staff this year include:·Dr. Suzanne W. Scott, English and STEPS (the PI version of EPICS); Dr. Ronald L. Miller, Chemical Engineering and STEPS; Ms. Dixie Termin, Executive Assistant to the Chief Academic Officer; Dr. Ronald Knoshaug, Professor of Mathematics;· Dr. Robert M. Baldwin, CSM/PI Coordinator and Acting Head of Chemical Engineering Program. In addition , Dr. Greg Holden, Department of Geology and Geological Engineering, spent a semester at the PI during Fall 2002.

Our hosts have been gracious and accommodating and the students are kind, respectful, and appreciative of our efforts to bring a "Mines-style" education to the UAE. We look forward to the future with a sense of anticipation and excitement.

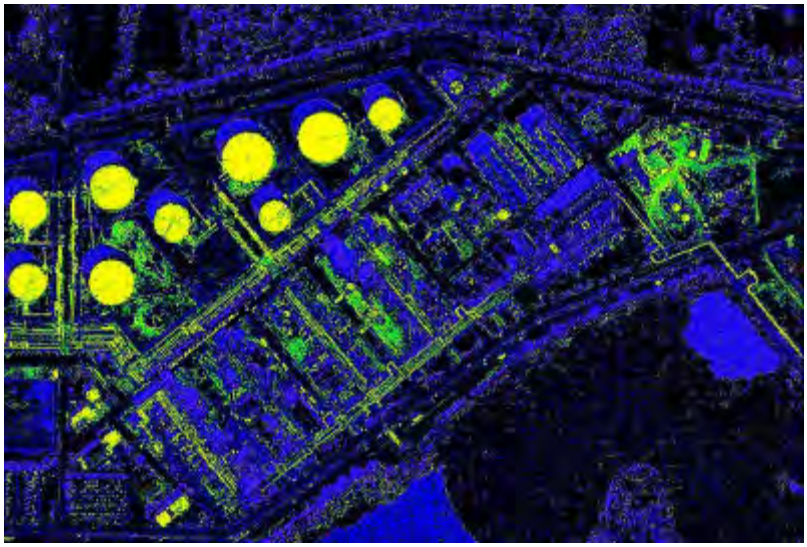
This article is excerpted from *Mines Magazine (*Spring 2004).

In addition to faculty noted in the article, Geophysics professors Davis and Young contributed to curriculum development. Professors Davis, Larner and Peeters have visited the PI. Peeters expects to spend two semesters there.

Monitoring Colombia's Pipeline Infrastructure

— Tamara Gipprich

The country of Colombia has been losing approximately 100 million US dollars annually due to theft along their state-controlled, EcoPetrol gasoline pipelines. Space Imaging, in Thornton, Colo., was asked to assess the feasibility of using their IKONOS satellite to monitor activity along Colombia's gasoline infrastructure. Due to her interest in remote sensing techniques, Tamara Gipprich, a geophysics graduate student, with the help of Professor Terry Young, assisted Space Imaging in this study.



Classification of the refinery in Barrancabermeja. Above-ground pipelines and tanks are yellow.

Using ERDAS Imagine software provided by Space Imaging to manipulate the imagery, Tamara found that the resolution was sufficient to identify lineations on the ground such as scarring where pipelines have been buried. Even with the limited data coverage available for this project, enhanced IKONOS imagery demonstrated the ability to track the pipeline and to offer a means of general surveillance of the petroleum infrastructure in Colombia.

This study utilized two sets of imagery. Initial study began with classifications, enhancements and interpretation of the city of Barrancabermeja, located north of the capital of Bogotá, where the above-ground pipeline infrastructure of the largest oil refinery in the country is readily identifiable. These results were then extrapolated to underground pipelines and to the second set of imagery in a remote region near the province of Sucre, where interpretation became more challenging.

Unfortunately, the limited data used in this study did not provide sufficient coverage to observe an incident of theft along the petroleum infrastructure. But Tamara has concluded that examination of imagery over the entire pipeline system would allow for surveillance of known or suspicious areas of theft. Advanced change-detection techniques could then be applied to imagery of these areas to highlight new and suspicious activities.

Space Imaging published a full report of this project in their Winter 2003 edition of "Imaging Notes". Tamara is very excited to have had the chance to work with Space Imaging and cannot wait for the next "remote" opportunity.

Enhanced image showing the location of a pipeline next to a dirt road.

Avalanche Rescue

…and when pigs ski…

Gary Olhoeft

What do you do when a student says he has to kill a pig for his Master's thesis?

Every year, hundreds of people are killed by snow avalanches. Victims suffocate to death within the first minutes after burial. Personal radio transceivers and a partner are the best method for surviving an avalanche. However, most victims are not equipped with a personal transceiver or it is separated from them by the forces of the avalanche. Search and rescue teams are then limited to a search probe line or rescue dogs. Probe lines require many people and consume too much time for a successful rescue. Rescue dogs are more efficient than the probe line, but have fundamental flaws limiting their effectiveness because of the dispersal, masking or trapping of scent. Ground penetrating radar (GPR) could provide a possible solution as snow is an excellent propagation media for GPR waves and a human body is a high contrast target relative to snow, serving as an ideal reflector target for GPR. However, it is unknown how GPR will respond to the unfavorably changing properties as a body freezes, and whether GPR can distinguish a human body from other natural and man made objects in the avalanche debris field. A body mass equivalent (BME) to a human was buried in snow, and the GPR response and core temperature were recorded versus time as the BME froze in a simulated avalanche burial. A pig was used as the BME, due to the similarity in properties to that of a human body. The pig was bought at auction on the way to a slaughterhouse, fed a temperature monitoring pill, euthanized by a veterinarian, and quickly buried in a snow bank at a cooperating ski area. A variety of other objects (skis, boots, poles, clothing) and temperature sensors were also buried nearby. Repeated measurements through several cold days and nights were performed with a ground penetrating radar system. The experimental measurements show that it takes about 110 hours for the 145 pound BME to completely freeze while buried in snow with an ambient temperature of -7 °C. Throughout the course of the experiment, the BME could be uniquely identified relative to other buried natural and man made objects by its imaging GPR signature. Modeling showed this was a consequence of a unique wavelet shape change from constructive and destructive interference occurring in a thin layer sequence at the BME-air-snow interface. This resulted from initial body heat melting of snow, development of a thin air pocket, and subsequent refreezing. Thus, GPR has the potential to image, identify and locate a human body and therefore possibly save lives, or at a minimum, help recover the body without having to wait for spring thaw. The graduate student, Justin Modroo, is currently investigating snow and avalanche conditions in situ while on the Extreme Freeskiing tour (where he was ranked 3rd in North America in 2003), while his graduate advisor, Gary Olhoeft, wonders what will happen next?

Justin Modroo hard at work collecting data.

Senior Design Project

Using Geophysical Techniques to Find Avalanche Victims

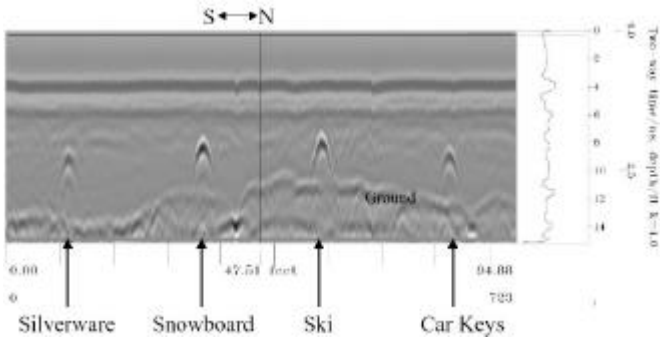
— Mike Batzle

In the mountainous regions of the western U.S., numerous outdoor enthusiasts each winter are caught in avalanches. Alpine rescue teams have recently asked the Department of Geophysics to assist in locating difficult-to-find victims.

Justin Modroo, a graduate student with Dr. Olhoeft, recently collected fundamental data documenting the temperature history of a BME or 'Body Mass Equivalent' (pig) buried in the snow. Justin also demonstrated the distinctive character of the BME on Ground Penetrating Radar (GPR) data (see article on preceding page). To develop this idea further and add information to help discriminate a victim from background debris, Douglas Klepacki, Marc Wennogle, and Jordan Dimick, all seniors, formed a team to combine electromagnetic (EM) data with the GPR.

One problem in identifying victims is the multitude of other objects also found in the avalanche debris field: such as trees, rocks and ice blocks. However, backcountry sports enthusiasts carry a variety of paraphernalia with them onto the snowfield. These could include skis, poles, keys, cooking equipment, knives, etc. If these objects can be detected and identified in the debris field, they could both lead to the victim and help discriminate them from noise created by the unrelated background objects.

In the pit covered with blue tarp, Doug (shown in the inset) acquires data as Marc and Dustin pull the GPR antenna sled over a grid of buried objects. Jordan, in his usual position, performs as middle management, passing along commands.



GPR data of one grid line showing a variety of objects commonly found with avalanche victims.

This design team, (un)officially known as NOS Inc. (Nerds on Snow), is working with the Ski Patrol of the Loveland Ski area to test their design under realistic field conditions. So realistic, in fact, that collecting data can be a real challenge. The photo shows the process of collecting GPR data in a snowstorm. Marc and assistant Dustin Lanci pull their fabricated antenna sled in the background. Meanwhile, Jordan relays instructions from Doug to the antenna crew (at the top of his lungs) to overcome the wind gusts. Doug collects the data, in a pit covered by the blue tarp (see photo inset). The pit proved necessary to prevent the snow and wind from disrupting data acquisition (and trashing the computer). At the end of the day, resisting the urge to leave Doug in the pit, Marc and Jordan opened the pit and retrieved both Doug and the equipment. The example GPR data (shown in the figure) show clearly the location of several of the buried metallic objects. Many of these items can also be identified on the EM data.

The Loveland Ski Patrol has been exceptionally helpful to the team in their project by locating and protecting the test site, and hauling equipment up and down the mountain (have you ever tried to get an EM61 antenna on a snowmobile). In fact, one of the volunteer members of the patrol, Debbi Miles, a graduate of the Geophysics Department at CSM, has even offered to plant herself in the snow to simulate a victim. Terry Young is acting as their faculty advisor. They are receiving both advice and encouragement from Knox Williams, Dale Atkins, and Halsted Morris of the Colorado Avalanche Information Center.

RCP Begins New Phase

— Kjetil Jansen

The Reservoir Characterization Project is in the initial stages of a new 2.5-year research project. Phase X (ten) will involve time-lapse, multi-component analysis of the Rulison Gas Field in the Piceance Basin, Colorado. The industry's demand for improved natural gas recovery has led Phase X to acquire the first 4-D and 9-C seismic survey over an unconventional gas reservoir (2003-05).

RCP students and Williams Company employees discuss the seismic equipment.

The field is operated by Williams Company, and is composed of gas-bearing channel sands. Solid State Geophysical Inc. collected the initial 3-D, 9-C survey in the middle of October, 2003. Two more surveys will follow the next couple of years, allowing for time-lapse analysis.

The goal of RCP Phase X is to create a high-resolution measurement system for monitoring changes in the rock and gas properties of the Rulison Field. In addition, the design of completion technologies for net reservoir recovery is also a goal of this phase.

Graduate students Lauri Burke and Kjetil Jansen discuss some of the initial survey results with Dr. Tom Davis during a recent seismic acquisition at Rulison Field, CO.

To achieve our goals, both surface and subsurface 4-D multi-component seismic surveys are underway. The information obtained will allow us to understand the subtle fracture networks that determine gas migration and accumulation.

Phase X is a multidisciplinary project with students from Geophysics, Geology and Petroleum Engineering. The group is comprised of students and faculty with a broad range of backgrounds, education, industry experience and nationalities.

Phase X will integrate the time-lapse multi-component seismic data with downhole measurements, geologic information, and production data to improve reservoir understanding. Veritas is processing the initial seismic survey, and CSM geophysics students Lauri Burke and Kjetil Jansen will analyze the data. The petrophysical aspect of the project will be worked on by Gaby Briceno and Eugenia Rojas. Chris Green is our petroleum engineer and will pursue the production data. Michael Ewing is working on visualization techniques. The geology is being done by Marielis Vargas, from CU Boulder. The focus of this integration is to push the limits of resolution in order to optimize the hydrocarbon recovery, to proactively engineer the reservoir.

The purpose of the study is to increase gas production while minimizing environmental impact. Key elements of this plan include monitoring reservoir depletion using seismic anisotropy, downhole measurements, production data, and geologic information. Ultimately, this data along with other attributes will be used to create a detailed reservoir model of the Rulison Gas Field.

Lauri and Kjetil and the vibrator truck that was the P-wave source during the Rulison Field seismic acquisition.

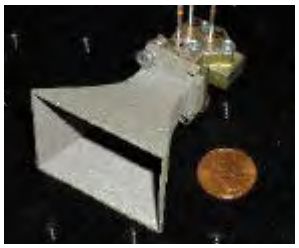
PAL

Physical Acoustics Lab

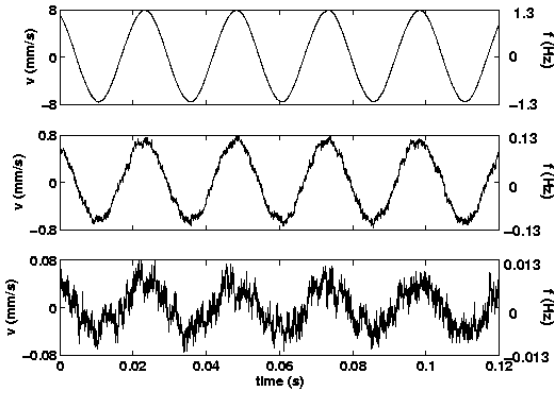
Explosive Efforts in Land-mine Detection

Over the last few years, students and faculty in the Physical Acoustics Lab (led by Professor John Scales) have developed a unique capability to measure acoustic and ultrasonic wave motion in a completely non-contacting fashion using lasers to both excite and detect the waves. Scanning the surface allows us to measure the entire wavefield, plus we can make measurements in hostile environments, such as ovens or vacuum chambers. Naturally, there is considerable interest in extending this technology to the field.

A new project funded by the Army Research Office aims to do just that. Our goal is to use state-of-the-art optical, acoustical and microwave technology to look for buried land mines from stand-off distances. According to the International Committee of the Red Cross in Geneva, land mines around the world claim a victim every 20 minutes. The UN estimates it will take $33 billion and 1,100 years to clear all the mined areas in the world with current technology.

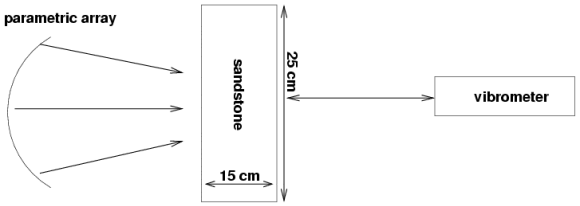


Here is a simple example of how seismic-frequency particle motion can be measured remotely with a home-made microwave Doppler vibrometer. Shown in the picture is a 24 GHz microwave transceiver with horn antenna (the penny is for scale). The transmitted and reflected signals are



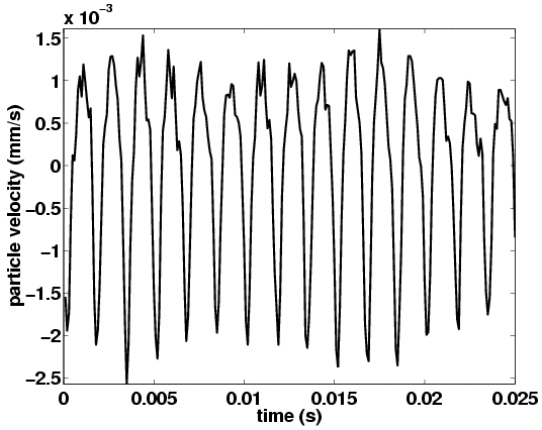
mixed internally and the target motion is output as an audio signal that can be viewed on an oscilloscope.

Next we tested a low-power commercial parametric array as a non-contacting seismic source. Unlike a conventional loudspeaker, which would be effectively a point source below 400 Hz or so, the parametric array emits a tightly collimated beam of ultrasound that is down-converted to acoustic frequencies via a nonlinear coupling of the ultrasound in the air. Next to the parametric array there is no audible sound.



Above is an experimental setup with the parametric array insonifying a block of sandstone. The resulting particle velocity is measured with a laser vibrometer. These results are for a 600 Hz driving frequency on the parametric array.

In order to achieve the best results in the field, we are in the process of building a high-power, focusable parametric array as a non-contacting seismic source, as well as robust detectors using microwaves and lasers.



The picture at the top of the page was taken using PAL's MirrorTron™ multiple-scattering lens. To the sharp eye, the picture includes a self portrait of John Scales.

Having Fun in Geophysics

Celebration of Mines

SSG Lunch

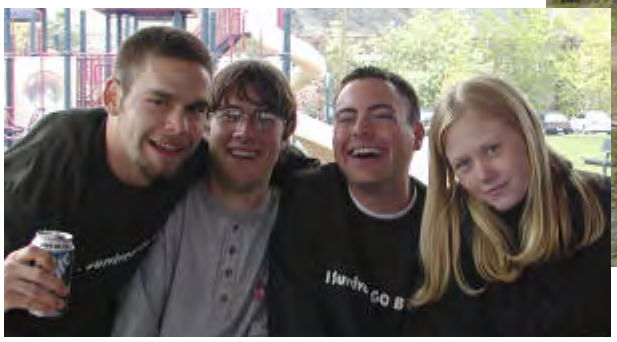
Bowling Night

Graduate Student Retreat

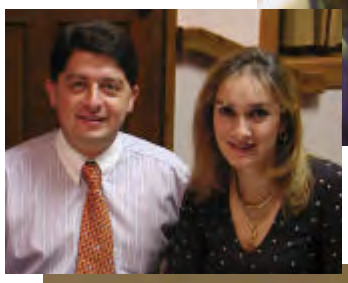
Ice Skating Party

GP Day 2003

Picnic: *Unpredictable weather & unpredictable students*



Banquet



JUST FOR FUN

GP Faculty Honors

Ken Larner Receives Prestigious Russian Award

Cecil H. Green Professor Ken Larner, was presented the Petr L. Kapitsa Gold Medal, the highest award given by the Russian Academy of Natural Sciences (RAS).

The award was made in recognition of Ken's distinguished contributions to geoscience, the theory and practice of seismic methods and his humanitarian activities during his 33-year career.

Ken attended the International Conference and Exhibition Moscow 2003 during September to receive the award, which is named for Petr Kapitsa who received the Nobel Prize in Physics in 1978 for his basic inventions and discoveries in the area of low-temperature physics.

In addition to this honor, Ken is a Foreign Fellow at RAS and was awarded the Maurice Ewing Gold Medal in 1996 by the Society of Exploration Geophysicists.

Ken has sight-seeing opportunities while in Moscow. He is shown here with Michele Tura (wife of Ali Tura, Shell E & P), Mary Fleming (SEG) and Jim Gaiser (WesternGeco).

Tom LaFehr Awarded CSM Distinguished Achievement Medal

Geophysics Department Distinguished Senior Scientist Tom LaFehr was presented a Distinguished Achievement Medal by the Colorado School of Mines during the May 2003 commencement ceremonies.

Tom is a leading scientist and spokesman for potential-field methods in exploration geophysics. He earned a M.S. in geophysical engineering at CSM in 1962. Shortly after receiving a PhD from Stanford, he became a partner in a small, company in Houston (Gravity Meter Exploration Company) and later held the George Brown Professorship at CSM.

He founded two companies, EDCON, a geophysical firm specializing in gravity and magnetic data acquisition, borehole gravity, and slimhole mineral logging; and LCT, Inc., which at the time he was Chairman and CEO, performed marine gravity surveys and developed GPS-based technology to acquire gravity data in fixed-wing aircraft. During this time, he also authored or co-authored several scientific papers that broke new ground in his areas of expertise.

Active in the SEG, Tom served as editor of Geophysics (1972-73) and as President (1983-84). In 1997, he received the SEG's Maurice Ewing Gold Medal.

Tom LaFehr celebrates with his wife, Arlys, and son, Ed, during the Geophysics Department graduation luncheon May 9, 2003.

Vanessa Mitchell First From CSM to Earn Churchill Scholarship

Geophysics senior Vanessa Mitchell has been awarded a Winston Churchill Foundation Scholarship to study next year at Churchill College, Cambridge University. This is the first time a CSM student has been recognized by the Churchill Foundation.

Vanessa will graduate from CSM in May 2004 with a double major in geophysical engineering and in economics and business, and with a minor in public affairs for engineers. She is a student in the Guy T. McBride Honors Program at CSM and was elected by her peers as 2003-04 president of the Society of Student Geophysicists. Vanessa entered CSM as class valedictorian of the Air Academy High School in Colorado Springs, a Colorado Boettcher Scholar and a National Merit Scholar. She spent a semester studying economics and management abroad at the Ecole Nationale des Ponts et Chaussees in Paris.

Vanessa has gained on-the-job experience through summer internships with Western Geco and with Dawson Geophysical. She has participated in the Undergraduate Research Opportunity Program at the University of Colorado, Boulder.

At Cambridge, Vanessa will earn an MPhil in Fluid Flow, after which she plans to enter Stanford University's Ph.D. program in environmental geophysics. She is particularly interested in acquifer characterization.

Vanessa gives credit for the Churchill scholarship award to the Geophysics Department professors and staff who were so supportive of her through the application process. "I've always felt that I had the full weight of the Department behind me over the last four years," states Vanessa.

In case you might think that academics consume Vanessa's full attention, you should know that she also dances with the Academy of Colorado Ballet in Denver and may also be found rock climbing, snowboarding or being a typical "Colorado college kid."

Congratulations, Vanessa, on a job well done!

Not Meaning to Brag…

Our faculty, students and former students often receive prestigious awards that reflect positively on the Geophysics Department. Here are a few recent noteworthy achievements.

• GP alumnus **Tariq Alkhalifah** (PhD , 1997) received the 2003 Conrad Schlumberger Award from the European Association of Geoscientists and Engineers.

Tariq Alkhalifah

This award is "for his highly significant contributions over the past decade and, particularly, for his elegant insight into details of seismic anisotropy which established well defined principles in seismic processing and led to a considerable enhancement in data quality, for his originality in thought and for his indomitable spirit."

Tariq is at King Abdulaziz City for Science and Technology (KACST), Saudi Arabia.

• GP alumnus **Edward Jenner** (PhD 2001) received the 2003 SEG J. Clarence Karcher Award. The award was given to Ed "in recognition of his contributions to the technology of exploration geophysics in the area of azimuthal 3D seismic processing with emphasis on the relationships of azimuthal variations of AVO attributes and velocity to reservoir properties." While at CSM, Ed studied with the Reservoir Characterization Project (RCP). He remains in Denver and is employed by GMG/AXIS.

• GP Professor **Ilya Tsvankin** and **Vladimir Grechka** of Shell International (formerly research associate with the Center for Wave Phenomena) received Honorable Mention from the SEG in the Best Paper category for their paper, "PP + PS = SS," which appeared in the Nov/Dec 2002 issue of Geophysics.

• GP and RCP alumnus **Reynaldo Cardona** (PhD 2002) was also honored by the SEG with the 2002 Best Student Paper Award. Reynaldo is currently employed by Chevron-Texaco.

• The work of the Reservoir Characterization Project, directed by **Tom Davis,** was highlighted in the July 2003 issue of *The Leading Edge*.

Graduation 2003

Congratulations! Seniors receiving Bachelor of Science Degrees during the Spring ceremonies were Greg Nelson, Emily King, Jessica Sigala, Katie Baker, Julia Oakes and Michael Root. Not pictured here: Luke Bernhardt and Amy Bean.

GP Celebration Masters of Ceremony Terry Young and Sara Summers

Prof. Tom LaFehr Displays the CSM Distinguished Achievement Medal.

All dressed up: Professors Ken Larner and Tom Boyd.

Maria Gabriela (Gaby) Briceno, MS.

Budi Muiz, Professional Master's.

2003-04 SSG officers: John Chakalis, Emily Roland, and Paul Schwering. (Not pictured: Vanessa Mitchell and Tanya Slota.

2003 Graduates

B.S. Degree

Omar W. Al-Kharouf
Kathleen L. Baker
Amy Lynn Bean
Luke Constant Bernhardt
Emily Rose King
Gregory Kent Nelson
Sarah Anne Nolan
Julia Dorean Oakes
Jonathan Allen Roberts
Michael John-Paul Root
Jessica Valerie Sigala

M.S. and M.E. Degrees

Maria Gabriela Briceno
Kumar Gautam
Kathleen McKinley
Kristen W. Sneddon

Professional Master's Degrees

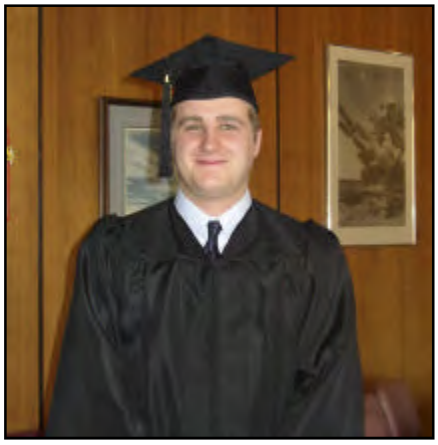
(Petroleum Reservoir Systems)
Budi Abdul Muiz

Ph.D. Degree

Albena A. Mateeva
Andrés Pech
Debashish Sarkar
Kasper van Wijk

PhD recipients Kasper van Wijk and Albena Mateeva with their advisor John Scales.

Advisor Ilya Tsvankin with PhD recipient Debashish Sarkar.



Jonathan Roberts, BS degree.

Sarah Nolan, BS degree

Class of '53 Class of '53 Class of '53 Class of '53

Class of '53 Class of '53 Class of '53 Class of '53

Class of '53 Class of '53 Class of '53 Class of '53

Representatives of the GP Class of '53 welcomed the Spring '03 graduates as new CSM alumni. Front row left to right: Vernon Adams, Dick Bank and Al Sabitay. Back row: Gordon Wieduwilt, George Minick, Jorge E. Castillo and Jack Parkin.

Guy H. Towle

As we went to press with this newsletter, we were saddened to learn of the death of our colleague, Professor Emeritus Guy H. Towle. Guy received his PhD from CSM in 1978.

The Center for Wave Phenomena Marks 20 Years

This year the Center for Wave Phenomena (CWP) is celebrating 20 years since its founding on the CSM campus.

The Center and its Consortium (supported by industry and government sponsors) was founded by a group of applied mathematicians, led by Norm Bleistein, who moved from the University of Denver to CSM in 1984.

The CWP faculty has evolved over the years, but gained a decidedly interdisciplinary nature when Geophysics faculty members Ken Larner (current center director) and Dave Hale joined the group in 1989.

CWP is noted for research contributions over a broad range of problem areas of fundamental importance to exploration seismology. These areas include aspects of seismic imaging — migration/inversion, estimation of elastic parameters, processing and interpretation of moveout and amplitude that takes anisotropy into account, imaging and velocity estimation in the presence of caustics, optimization, statics estimation and correction, analysis and interpretation of multiply-scattered waves for changes in subsurface properties, to name a few.

CWP faculty: Ilya Tsvankin, Ken Larner, Martijn de Hoop, Roel Snieder, and Norm Bleistein.

While maintaining and expanding their research activities, the focus of the CWP faculty is to educate and nurture their students in an open and friendly atmosphere. To date 59 students have earned graduate degrees under CWP support and are making contributions to the industry and academia worldwide. Happy Anniversary, CWP.

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Colorado School of Mines
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Golden, CO 80401-1887

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