geophysics

Colorado School of Mines

Spring 2003

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Greetings from the Department Head

If there is a unifying theme in this Spring 2003 newsletter, it is the international impact of the Department of Geophysics. Summer Field Camp took on an international dimension by the participation of faculty and students from the University of Central Venezuela. During the summer our graduate students were abroad contributing to NATO conferences in Corsica and the Czech Republic. In Fall semester, Professor Max Peeters served as a visiting faculty member at Curtin University of Technology in Perth, Western Australia. Between semesters two of our students were in Marbella, Spain, participating in Shell's Business Challenge. Though not covered by articles here, two other undergraduates studied abroad last year, Julia Oakes in England and Vanessa Mitchell in France, and a third, Amy Hinkle, enjoyed her adventures as a co-op student working in Venezuela. Some faculty travels abroad are highlighted as well. Our alumni aren't about to be outdone, look for a report from Erin Kock of Oxy. Misti Williams and Rachel Vest of Blackhawk GeoServices visited campus to tell undergraduates about their work in Hong Kong. In this newsletter we focus on our Distinguished Senior Scientists, an internationally diverse group of individuals who have made a global impact on the world of geophysics. And please read about the honors bestowed on department members during this year.

Warmest regards,

Cover Photo: Derek Wilson

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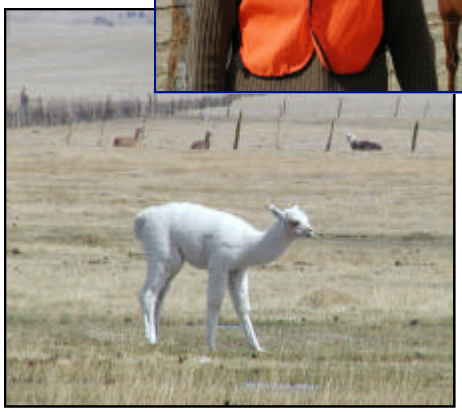
Venezuelans Attend Field Camp

The 2002 Summer Field Camp took on a different flavor this year, as we were joined by faculty and students from the University of Central Venezuela (UCV) in Caracas. In return, UCV invited CSM seniors in geophysics to go to Venezuela in March 2003 to attend the UCV field camp. Unfortunately, political unrest in Venezuela forced postponement of a reciprocal visit.

Venezuelan visitors to Field Camp: José Ignacio Trujillo, Ricardo De Marco, Lorenzo Izarra and Professor Inirida Rodriguez, Head of Geophysics Department, University of Venezuela, Caracas. Not pictured is faculty member Maria Gabriela Castillo.



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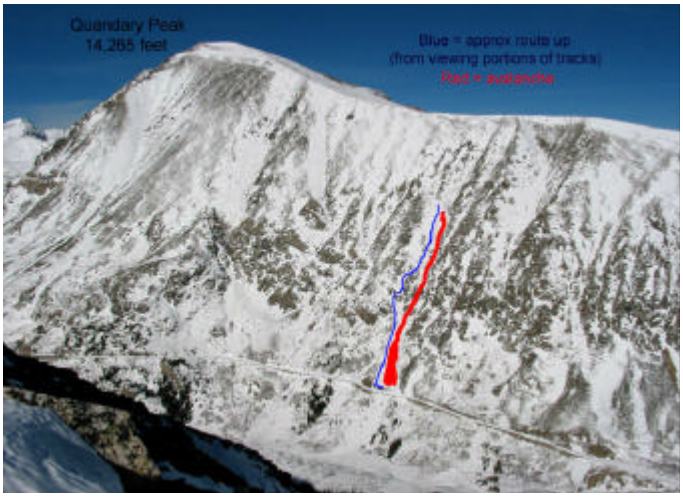


Survival:
Quandary Peak
Avalanche

While "survival" to most of their classmates may conjure up the TV-show images of warm beaches and bug-eating antics, for CSM students Andy Kass and Matt Wisniewski "survival" brings a different image entirely.

Pursuing their mutual goal to climb all of Colorado's '14ers' by graduation, the two avid climbers were ascending a steep, rocky gully on the south side of Quandary Peak near Breckenridge, November 15, 2002.

According to the Colorado Avalanche Information Center, a series of Pacific storms had brought abundant snows to the Tenmile Range during October and early November, leaving a snowpack that was unusually deep and strong. In addition, strong northwesterly winds on November 12 and 13 had caused significant blowing snow and slab formations. The avalanche danger rating for the day of their climb was "moderate", but there was a warning to "use extra caution in all steep terrain."

After summiting, the plan was for Andy to ski down, and for Matt (the more experienced climber) to hike. Before that could happen, however, a slab avalanche broke free, sweeping both of them with it.

Andy tumbled for 200 feet before stopping and lay unconscious for two hours. He awoke cut and bruised. Using the skis from his pack, he marked his position and began a slow and painful descent toward the valley, falling and further injuring himself along the way.

Andy Kass—doing what he loves, and Matt in class at CSM, Fall 2003.

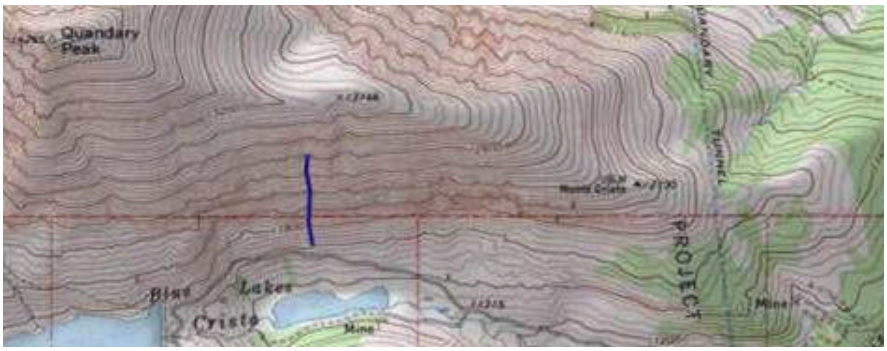
In the fading daylight, Andy miraculously discovered Matt alive at the base of the gully where he had been swept along the surface—a fall that was later calculated to be 1,500 feet in 15 seconds—and he was seriously injured, but conscious.

Wrapping Matt in extra clothing and leaving a light with him, Andy proceeded another two miles for help.

Paramedics retrieved Matt, but his survival adventure was not over. He suffered a broken back and pelvis, a torn rotator cuff, a broken forearm, a ruptured spleen, frostbite and severe hypothermia. In transit to the hospital (by ambulance and then by helicopter), he was resuscitated twice.

We are pleased to report that Matt is now nearly recovered at his home in Massachusetts and plans to return to his CSM studies in geophysics next term.

The Colorado Avalanche Information Center reports what Andy and Matt already know— "This time, they were very, very lucky."



Readers may want to visit the Colorado Avalanche Information Center (CAIC) webpage at http://geosurvey.state.co.us/avalanche/. Avalanche forecasting by this organization is sponsored in large part through donations by the Friends of CAIC: http://geosurvey.state.co.us/avalanche/Friends/Friends.html.

Have you ever been to Gourami?

Not Your Typical Holiday

— by Sarah Shearer & Jordan Dimick

Over the week of January 3-9, 2003, Jordan Dimick and Sarah Shearer traveled to Marbella, Spain, to participate in Shell's Gourami Business Challenge. As part of 80 students from the United States and Europe, Jordan and Sarah were charged with developing a five-year strategic business plan for the fictional country of **Gourami**. Although the setting was fictional, the adventure was realistic, demanding, and an experience of a lifetime.

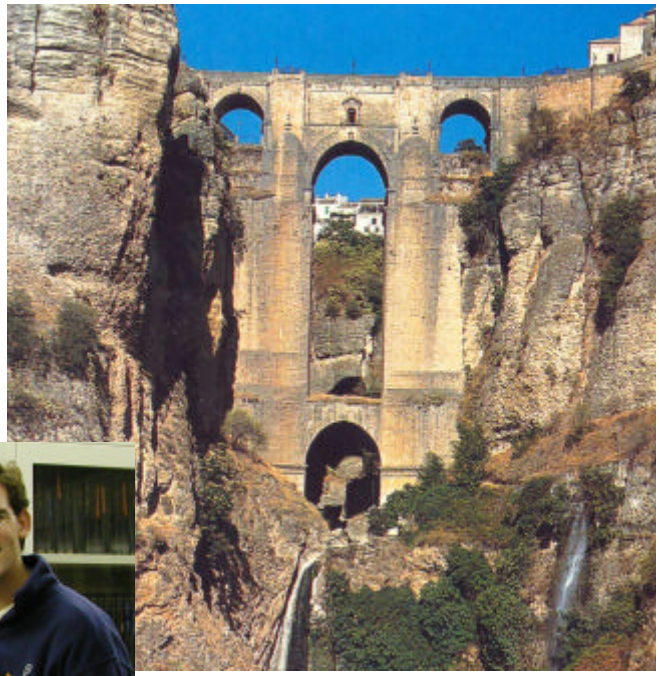
Each group of forty students was broken into smaller teams focusing on the various aspects of the energy industry, such as sales and marketing, refinery, exploration and production, human resources, finance, and corporate strategy. Working alongside students with diverse backgrounds from a variety of prestigious universities, Jordan and Sarah could have been intimidated. But the presence of knowledgeable Shell mentors, coupled with their education from Mines, made both Jordan and Sarah confident in their ability to contribute to their respective group's tasks.

Cramming a process that takes industry six months to complete into four days makes for an intense experience. Initially, each group brainstormed and evaluated possible scenarios for development and cooperative agreements. Responsibilities true to industry included meeting with other Gourami partners, industries, and officials; performing risk assessment on health, safety, and environment; and calculating costs. The culmination of each group's work was presented at a target and resources "fishbowl" meeting on the evening of the third day at which final projects were decided based on a projected budget.

Frustrations and complications were rewarded on the final day of the business challenge when students presented their strategic plan to three Shell shareholders. After trying presentations, both teams were excited to gain shareholder approval for their development plans, thus ensuring the economic future of Gourami. In celebration of dual success, a karaoke extravaganza was held for all 80 students after a meal that was not plagued by shoptalk discussions.

But this adventure was not all work. Shell mentors were conscious of the students' need for distraction from the project. Recreational activities were offered each afternoon, and a "monsoon" swept through Gourami one evening, knocking out electrical service and forcing students to retreat to the bar. On the final day, the students were taken to the mountain town of Ronda giving them the opportunity to experience the culture and countryside of Spain.

When the week was over, international friendships had developed, personal strengths and weaknesses were recognized, and an awareness of the energy industry had been born. Gourami may not have been a holiday, but it was a priceless experience.



Sarah Shearer and Jordan Dimick point to where they "think" Gourami is located; they are sure about Ronda, Spain, and its Puente Nuevo (New Bridge) pictured above.

Grad Students Attend NATO Institutes

– by Erin Wallin and Kasper van Wijk

The Astronomical Clock in Old Town Square: Prague
– Photo by Susan Hubbard

This past summer four geophysics graduate students were chosen to participate in the NATO Advanced Study Institutes (NATO-ASI). Matt Haney, Kasper van Wijk, and Alex Grêt went to Cargese, Corsica to attend "Wave Scattering in Complex Media." Erin Wallin attended the ASI in Trest, Czech Republic, titled "Hydrogeophysics: Improved Subsurface Characterization using Integrated Hydrogeological and Geophysical Data."

The Trest institute was a busman's holiday with sessions on stochastic hydrogeology, flow and transport in the vadose zone, geoelectric, electromagnetic, radar, seismic, borehole, and NMR geophysical methods, hydrogeological-geophysical data integration and field demonstrations. Erin presented a poster on "Forward modeling for High Frequency Sounding: A technique for monitoring PCE: KMnO4 saturations under a conductive overburden."

Along with the diverse set of topics that were covered, there was a diverse group of people with over 19 countries represented.

It was a priceless experience to spend two weeks with them. Erin especially comments on two things: first, how quickly the participants became friends, in spite of having different religious, political and economic backgrounds; and second, the tremendous variety in research topics that people are working on.

Although the agenda was full, there was some time to visit Prague. The Astronomical Clock in Old Town Square is a popular tourist site. The clock depicts Prague as the center of the World, which contradicts what Tom Boyd teaches in his class, Physics of the Earth…that Golden is the center of the Universe.

Meanwhile, in Cargese, Alex gave a presentation on "Coda Wave Interferometry" while Matt and Kasper exhibited posters on the diffusion of elastic energy.

In addition, Matt was the "Troubadour Extra-Ordinaire" lending enlightenment to the discussions on the beach about the science of scattering (his own) acoustics.

ASI by the sea in Corsica; and Troubadour Haney studying acoustics on the beach.

There's Just Something About Hardhats

— by Emily Roland, Geophysics Sophomore

Emily on the job.

I am not sure which is more difficult: explaining to a bunch of engineers that I work in the summer as a forest firefighter, or explaining to a bunch of firefighters that I'm studying geophysics at the Colorado School of Mines.

I fell in love with firefighting in the Summer of 2001. During my senior year in high school I applied for a job with the U.S. Forest Service, and headed to Trout Lake, Washington, shortly after graduation. There I worked on a fire crew for the Mt. Adams district of the Gifford Pinchot National Forest. After completing the week-long fire school and passing the physical endurance *Pack Test*, I really started learning what the job entailed, and by the end of the season I had my parents worried that I was going to scrap the college idea altogether.

Depending on the fire conditions, crews are either kept near home for initial attack, or are sent out, on 20-person hand crews or three-person engine crews. During this past summer of record-breaking fire conditions, I did both.

After returning home from school and spending what seemed to be an endless few weeks hearing about Colorado burn in the fire reports, I was finally dispatched to Rifle, Colorado, with my engine, and made the thousand-mile drive for the second time that month. We assisted other Forest Service BLM, and contract crews there for about 18 days and worked the Glenwood Springs Coal Seam Fire, and the Spring Creek Fire about 15 miles to the west.

The conditions in Colorado were a big contrast to Washington. The living fuel moisture levels resembled those of dead vegetation and nearly every day reached temperatures over 100 degrees. At the end of our tour, we had two days of R&R at home before I was again dispatched, this time on a 20-person crew to Oregon, which by then was just as hot as Colorado.

In Oregon I worked in sage land, forest, and national wilderness on the Mahogany Complex, the Flagtail Fire, the High-Richard Fire, and the Malheur Complex. At one point, our crew was at a fire camp with 1600 other workers and could see three type 1 (the most severe) smoke columns from three different directions.

We worked from 12 to 16 hour-days, digging fire line, running hose lays, "mopping up", and burning out. On the crew, I was responsible for taking weather and was one of the four sawyers (packed and used the saws). At night, we would head back to our tents, eat incredible meals (steak, salmon, ribs, lasagna), bandage our blisters, and "hit the hay" (at one point we were literally camped in a farmer's hay field). By the middle of August, we were all ready to head back home, and spent the drive discussing what we were going to buy with our hazard pay, night differential pay, and all-important overtime pay.

It's hard to decide whether it is the people I've met, or the experiences I've had that make my summer job so unforgettable. I guess it is both the friendships and excitement that are compelling me (against the advice of my parents) to hold out on internships for one more summer, and I will be returning to work as soon as school is out!

Emily poses here with celebrity Smokey the Bear.

Freshmen Explore Geophysics

CSM Freshmen take on challenge of instrument design

– by Tom Boyd, Associate Professor

Using seismometers as a catalyst, the Colorado School of Mines (CSM) teamed with the IRIS Consortium*, and the USGS to expose the 2002 CSM freshman engineering class to geophysics and instrument design. As part of the Engineering Practices Introductory Course Sequence (EPICS), 350 students worked to design an inexpensive seismic system for use in educational environments. Students were provided with design specifications that included:

- the capability to record surface waves from earthquakes anywhere on Earth of magnitude 6.5 and larger
- a design execution appropriate for non-technical operators and for use in a classroom environment
- a total consumer cost of less than $150 (exclusive of a PC).

Creativity abounded during the 2002 EPICS class challenge to devise a classroom-friendly seismometer.

Students were first introduced to the field of observational seismology and instrument design by IRIS Education and Outreach Committee members John Lahr (U.S. Geological Survey), and Tom Boyd (Colorado School of Mines). Drs. Lahr and Boyd also provided guidance for many of the groups.

Teams researched the project through standard resources as well as from numerous CSM faculty and USGS staff. Given the variety of input, it's not surprising that a wide array of design approaches were explored by the student teams.

Some groups decided to utilize traditional seismometer designs and to explore how these could be constructed at reduced cost. Others explored non-traditional designs that included levitated graphite systems, microchip accelerometers and even a hula-dancing doll.

From the 70 student groups, the CSM faculty and USGS volunteers from the Earthquake Hazards Team selected 17 finalists for entry into the 2002 EPICS Challenge competition.

Judging for the competition was based on how well the entries met the design criteria, the quality of the execution of the design, and the quality of the presentation made by the design team. Middle school students participated in the judging as potential customers of the classroom seismographs, assessing the appeal and intuitiveness to classroom students.

The top design team produced a working prototype of a diamagnetic seismometer. This horizontal component seismometer senses the position of a piece of graphite suspended in a magnetic field. A design utilizing a compact horizontal component seismometer based on a clever folded-pendulum design was awarded second place. A full description of the top designs is found at

http://www.jlahr.com/science/psn/epics/index.html.

Winning designs received cash awards, and in addition, CSM faculty will select one student to be supported by IRIS as a summer intern at the PASSCAL instrument center during Summer 2003. Some finalists continue to refine their seismometer designs during the spring semester of the EPICS project.

1st Place team of the design challenge: (left to right) Matt Briggs, Jason Millheim, Heather Fenstemaker, Brodie Griffin and Brooke Carmack.

While the development of a fully functional, inexpensive seismometer is highly desirable; the true success of the program is based on the interest and effort that was demonstrated by the students, the open-ended, problem-solving instructional techniques used in classes, and the exposure of these students to geophysics as a possible career.

*IRIS, the Incorporated Research Institutions for Seismology is a university research consortium dedicated to exploring the Earth's interior through the collection and distribution of seismographic data.

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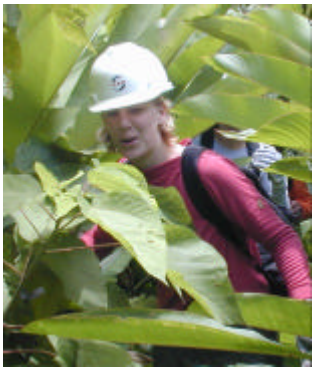
GP Alumni
Keeping in Touch



In Equador to review procedures and parameters used in a 3D seismic survey: (left) A co-worker and Erin before their first grueling hike through the rainforest, (right) looking for the geophone line that was cleared two months ago… There used to be a path through here. It was a lot more work than when I visited a 3D survey in Kansas!

Erin Kock '01

Note: *One year ago, Erin was pictured in our newsletter sporting a water gun during Department spring festivities. Read below to find out what Erin has been up to since then.*

After graduating from CSM, I would never have predicted what was in store for me when I chose to work for Occidental Oil and Gas (Oxy) in Houston.

Since leaving Golden, I have flown in helicopters, seen the Eiffel Tower, stayed at a world-class bird sanctuary, spent a week trekking through the Oriente rainforest in Ecuador, enjoyed dinner at the Moulin Rouge, traveled throughout the United States (in first class)—all as part of my training with Oxy.

From those experiences and from the more mundane daily life of fluorescent lights, early hours and an abundance of computer screens, I have learned volumes about geology and geophysics (the two are more intertwined than some would like to believe). I've participated in seismic data processing, evaluated seismic data acquisition procedures, and interpreted miles of seismic data. I've helped identify drilling targets in Yemen and have seen the results. Since September 2002, I have been working on a team to evaluate different methods to extend the life of one of Oxy's fields in California. I anticipate being in California another year or two, but I've certainly learned that you can't always predict what happens next!

Misti Williams & Rachel Vest '02
SSG Taps into Alumni Experience

Alumni Misti Williams and Rachel Vest, employees of Blackhawk Geosciences.

Part of the SSG monthly lunch bunch.

The Society for Student Geophysicists (SSG) holds regular meetings throughout the school year, with one of its primary goals being to expose future geophysicists to career opportunities. Two 2002 graduates, Misti Williams and Rachel Vest, recently spoke to the group concerning their projects as employees of Blackhawk Geosciences.

Both women work on Unexploded Ordnance (UXO) projects, surveying sites for undetonated explosives. Misti spoke about her recent work in California and Rachel spoke of her experiences on the construction site of the new Disneyland Park in Hong Kong.

The Department is honored by the participation in our program of five Distinguished Senior Scientists pictured here: on the left is Pieter Hoekstra; and on the right are Adel Zohdy, Warren Hamilton, Misac Nabighian and Tom LaFehr.

In the Spotlight:

Distinguished Senior Scientists

One of the great legacies of Dr. Phil Romig's tenure as Head of the Department of Geophysics is a group of faculty members known as the Distinguished Senior Scientists. During a recent Department seminar series, we enjoyed hearing the stories of these outstanding individuals. In the following pages we share those stories with you.

Each of our Distinguished Senior Scientists earned international recognition for his contributions to geophysics before "retiring" in Colorado: Dr. Pieter Hoekstra in environmental and engineering geophysics, Adel Zohdy in groundwater geophysics, Warren Hamilton in geodynamics, Misac Nabighian in mining geophysics, and Tom LaFehr in gravity and magnetics. It is apparent from their ongoing contributions to the Department of Geophysics that none of these Distinguished Senior Scientists has really retired.

Recently Pieter served as General Chairman of two important technical meetings, the 2001 Symposium for Applications of Geophysics to Environmental and Engineering Problems (SAGEEP) in Denver and the 2002 Annual International Meeting of the Society of Exploration Geophysicists in Salt Lake City. Adel served as Technical Program Chairman for the SAGEEP meeting. If you thought the book had already been written on plate tectonics and geodynamics, you haven't tuned in to the recent work of Dr. Warren Hamilton. Misac Nabighian recently taught a graduate course in advanced electromagnetics, which was so well received that the grad students prevailed on Misac to teach an impromptu course in complex variables theory. In spite of his ongoing leadership in industry, Tom LaFehr finds time to drive over from the Western Slope each month to give guest lectures in potential fields and to contribute to research in the Gravity and Magnetics Research Consortium. As a group, they expand the breadth and depth of expertise of our faculty. We are grateful for their diverse contributions and wise counsel.

ADEL ZOHDY

I was born and raised in Alexandria, Egypt. My sport activities in high school included soccer, tennis and squash. Later, in college, I became a serious competitive swimmer. Snorkeling and spear fishing in the Mediterranean were my favorite non-competitive activities. I graduated from the University of Alexandria with a B.Sc. in geology. Upon graduation, I taught chemistry and physics at Victoria College, Alexandria. The following year I became a teaching assistant in geology at the University of Alexandria and I also taught physics and chemistry at the British Boys School. Within that year, I received a scholarship to come to the United States.

In September 1959, I came with my wife and our 5-month-old daughter to the University of California at Berkeley to study geophysics. My strong undergraduate background in paleontology, stratigraphy, mineralogy, and petrology was not very useful to me as a graduate student in geophysics. I took 52 semester hours in math, physics, and solid earth geophysics to catch up and become a geophysicist. I worked as a lab assistant and made induced polarization measurements on core samples. During one summer, I was hired by the University of Illinois, Humboldt River Project, as a geophysical field assistant for groundwater work near Winnemucca, Nevada.

Exploring buried stream channels using electrical resistivity in Santa Clara County, CA (circa, 1963).

In 1962, I got my Master's degree in geophysics from UC-Berkeley and I transferred to Stanford University to pursue my interests in exploration geophysics. One quarter, I wanted to sign up for a course in electrical methods but my advisor said, "No . . . you are going to teach it." I taught that course, and I learned more about electrical methods than had I taken the course as a student. I also worked as a teaching assistant for other courses. At Stanford, at that time, the Ph.D. comprehensive exam was a grueling five-hour oral exam. My committee was composed of two geophysicists, a hydrologist, a mining engineer, and yes, a paleontologist. Switching from deriving Poisson's second relation to identifying a Triassic index fossil was fun. I did very well and I passed. Subsequently, I worked on my thesis: resistivity and seismic refraction studies in the Santa Clara Valley, CA. I successfully defended my thesis and I graduated from Stanford in 1964.

In 1965, I joined the US Geological Survey. I made electrical geophysical surveys in Alaska, Arizona, California, Colorado, Florida, Georgia, Hawaii, Idaho, Maryland, New Mexico, Nevada, North Carolina, Texas, Utah, and Yellowstone National Park. It was very exciting work because test holes, including those that reached more than 6,000 feet, followed many of my surveys. I developed methods for the automatic interpretation of sounding curves, for total field mapping and sounding, and for differential soundings.

I wrote several computer programs for the acquisition, interpretation, and presentation of resistivity data. My fieldwork was primarily related to groundwater exploration in deep basins, geothermal exploration, and earthquake prediction studies. I published more than 75 papers, reports, and computer programs. While at the USGS, I learned Russian and I explored the vast Russian literature on electrical methods. I translated a few Russian articles, edited several others (including a book), and I translated a few French articles. Several of these articles were published by the USGS.

I traveled abroad extensively as an advisor, an interpreter of electrical data, and as a lecturer. The countries I visited included Brazil, Egypt, Portugal, Saudi Arabia, Sri Lanka, Sicily, and the former Republic of Yugoslavia. I also visited several organizations in France, Germany, and Spain.

From 1980 to 1984, I served as Chief of the Branch of Electromagnetism and Geomagnetism and then as Chief of the newly reorganized Branch of Geophysics (with nearly 250 employees).

During my career, I received several awards including the Department of Interior Meritorious Service Award, the Colorado Scientific Society Past Presidents Award, and an SEG Best Presentation Award at a Mining session. I served the SEG as Associate Editor for Electrical Methods, and recently, I served EEGS as Technical Program Chairman for the SAGEEP Meeting in 2001.

For more than 25 years, my hobby was to train and compete with my German Shepherd Dog(s) in obedience, conformation, and in Schutzhund (a German dog sport involving tracking, obedience, and protection).

After 30 years of service I retired from the USGS and joined the CSM Department of Geophysics where I enjoy teaching electrical methods and groundwater geophysics.

Misac Nabighian

I was born and raised in Bucharest, Romania, where I did all my undergraduate studies. Although I played goalie on the high school soccer team and was also a member of the high school chess team, I was the typical nerd, finishing Valedictorian both in high school and college. However, to put things in perspective, the nerds in Romania commanded the same kind of attention that the jocks command in the United States.

Left: Misac performing an electrical resistivity survey for locating copper deposits in Romania.

Below: Relaxing between assignments in Morocco.

I was fortunate in college to study under the supervision of Professor Sabba Stefanescu (of "Stefanescu's kernel" fame in DC resistivity studies). After graduation I was appointed party chief of a geophysical survey crew and for three years I carried out exploration in search for copper deposits in Eastern Carpathians. I was then called back to the University to become the assistant lecturer for Professor Stefanescu. We worked closely together, publishing a number of papers, one of which received the Romanian Academy of Sciences prize for "theoretical elegance and beauty." Although a superb mathematician, Professor Stefanescu always tried to look at the physics of the problem first, think what the final solution should look like based on his physical intuition and only then did he attempt to prove his conclusions mathematically. I cannot express my gratitude to him in enough words: he was and still is such an inspiration for me. I still keep a large picture of him in my office at home, and anytime I run into a difficult scientific problem, I look at his picture for inspiration.

In 1962, I left Romania and came to the United States. By sheer accident, I ended up at Columbia University and I started working at their Lamont (now Lamont-Doherty) Geological Observatory where I received a PhD in Geophysics. These were very exciting times when magnetic data were first used to prove the theory of ocean-floor spreading. While still a graduate student I was first hired as a consultant and later on as a full-time employee by Newmont Exploration Ltd., the research branch of Newmont Mining located in Danbury, CT.

Again, fortune smiled on me as I was associated there with one of the pioneers and grand men of mining geophysics—Dr. Arthur Brant, the Director of Geophysics. Dr. Brant gave us free rein to pursue our interests with minimal interference.

After Dr. Brant's retirement, the group was moved to Tucson, AZ, and I was again fortunate to work under the leadership of Dr. Marie Davidson, a superb physicist and computer expert. Finally the group was moved to Denver, CO, and after a few more years here, I decided to retire. During my 31 years at Newmont, I worked in all areas of exploration geophysics except seismic. Mostly due to my work on the "Analytic Signal" in potential fields and on the so-called "Smoke-Ring" in time-domain EM I was elected Honorary Member of the Society of Exploration Geophysicists and received the first Gerald Hohmann Award for excellence in electromagnetics. In addition, my alma matter awarded me the title of Professorem Honois Causa and my "Smoke-Ring" paper was selected as one of the all-time classic geophysics papers and was re-published in a special issue of Geophysics for the 50th anniversary of SEG.

While I was pondering retirement, Dr. Phil Romig (then CSM Geophysics Department Head) made me an offer that I could not refuse. The last four years as Distinguished Senior Scientist at CSM have been some of the most enjoyable years in my life. I currently teach two courses, Mining Geophysics for geophysicists and Applied Geophysics (with Prof. Tom Boyd) for non-geophysics majors. I am also associated with the Gravity and Magnetics Research Consortium (GMRC) where I have a very rewarding collaboration with Yaoguo Li.

I was fortunate in my life to be associated with great scientists, to be given reasonably free rein to pursue my interests, and to be given the opportunity to travel to great places in style (at least in the early years with Newmont). I was also very lucky to find an ideal wife in Aida to whom I've been married 36 years. We have a grown son and daughter.

PIETER HOEKSTRA

I was born and raised in Amsterdam in the Netherlands and was convinced at an early age that even though the grass may not be greener on the other side, for sure the sun would shine more. With this concept in mind, I started towards an education in tropical agricultural engineering. Quickly realizing that one must follow where opportunities lead, I accepted a scholarship at McGill University in Montreal, Canada, majoring in physical chemistry.

Part of the duties of that scholarship consisted of teaching introductory physics to a class of students in home economics. I would strongly recommend teaching such a class to every foreign student deficient in the English language. Those wonderful ladies, whose interest in physics was legendary, were merciless in exposing goofs in language skills. From there I went on to earn a PhD in engineering physics at Cornell University.

Hoekstra (on the right) "selling" geophysics to Army generals during his first job with the U.S. Army Corps of Engineers.

My first job was in the U.S. Army Corps of Engineers, Cold Region Research and Engineering Laboratory in Hanover, NH. It was there that I started on a career in exploration geophysics researching, developing, and testing ground and airborne geophysical techniques for determining physical properties and mapping distribution of ice, snow and frozen ground (permafrost). With the discovery of Prudhoe Bay field, the need for engineers with Arctic experience was acute, and I took employment with Northern Engineering Company Ltd., as Manager of Geology and Geophysics, in Calgary, Alberta. This company was formed by a consortium of the major oil companies to evaluate the feasibility of constructing a gas pipeline from Prudhoe Bay to the lower 48 States.

Pieter working with students and faculty at Field Camp 2002.

When it was decided to build such pipelines in the 21st rather than in the 20th century, I formed several consulting engineering and contracting companies in Calgary (Geo-Physi-Con) and Golden, CO (Blackhawk Geosciences). Those companies mainly performed geophysical contracting and consulting services in mining and groundwater exploration, and for geotechnical and environmental engineering. I retired from those companies several years ago and am now pleased to impart some of the knowledge and experience gained during my varied career by assisting in teaching undergraduate courses at Mines in electrical and electromagnetic exploration.

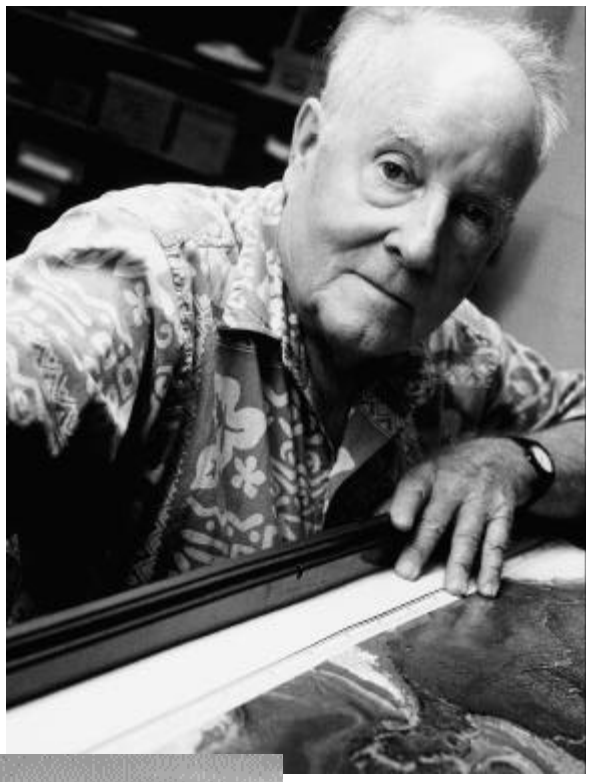
On sea ice in Pt. Barrow Alaska.

Warren Hamilton

I enrolled in freshman geology 60 years ago. Many of the concepts I then learned have proved false: scientific consensus did not then, and does not now, define truth, and there has always been much room for new fundamental interpretations.

Most of the concepts and data types that I now use did not then exist, and it has been my privilege to help develop them. Early I became (with an interruption for Navy service) a field-oriented petrologist and structural geologist, and my Ph.D. thesis (UCLA, 1951) was on High Sierra granites. My employed career was USGS research, mostly headquartered in Denver, first in a geologic unit, and later in a geophysical one as my work became increasingly multidisciplinary.

Restless by nature, I worked with all sorts of geology in varied regions—among others Southern Appalachians, California and Nevada deserts, Northern and Canadian Rockies, Alaska, Antarctica, Indonesia—and I junketed geologically in 50+ countries. Such exposure to diversity and geoscience attitudes and methods as well as in geology and terrain provided invaluable background for integration.



Warren was recently featured in the October 2002 Denver publication, *5280 Magazine*. The photo above accompanied that article and was shot by John Johnston. On the left, Warren poses on Mt. Erebus, Antarctica in 1958.

In addition, to the descriptive maps, papers, and monographs published from my formal projects, I prepared regional and topical syntheses on crustal evolution. Early ones included the first recognition of magnitude of processes with crustal depth. I was one of the very few actively writing American Continental drifters before plate tectonics demolished stabilism in the late 1960s. By then I had global geologic knowledge that enabled rapid integration of continental geology with plate tectonics.

I spent most of the 1970s working with marine geophysics and onshore geology of Indonesia and surrounding regions to produce what remains the broadest integration anywhere of products and processes of convergent plate tectonics. Varied topics of tectonic and magmatic evolution—the structural and magmatic modes of crustal extension, the mechanics of subduction, the nature of arc magmatism through upper mantle and crust, many others—took me through the 1980s and early 90s.

I retired from USGS in 1995 and stayed for a year as a volunteer, but then Gary Olhoeft and Phil Romig arranged the rewarding association with the Department of Geophysics and its fine faculty at Mines that I now enjoy. From my basement office in the Green Center, I continue almost full time to seek alternatives to conventional theories that appear to be weakly based, and have published major contrarian papers on crustal and mantle evolution of the early Earth and on modern mantle dynamics.

I have had a career of great fun figuring out how the Earth works. Recognition during this life of play has been a bonus and includes the Penrose Medal (highest award of the Geological Society of America), membership in the National Academy of Sciences, visiting professorships at Yale, Caltech, Amsterdam, and Scripps Institution of Oceanography, and hundreds of invited lectureships. Mines calls on me for a little guest lecturing in geophysics and geology, and for field camp help.

Alicita and I, married 55 years, watch our three children and six grandchildren with intense pride and love.

Tom LaFehr

Tom LaFehr will be awarded a Distinguished Achievement Medal at the CSM May 2003 commencement ceremonies.

As an undergraduate at Berkeley in the 1950s, I was searching for a career field when I took an introductory course in earth science from Professor John Verhoogen. This experience convinced me to become a geophysicist and to specialize in gravity and magnetics.

In 1964, I received my PhD in geophysics at Stanford University with an interest in gravity studies in the Southern Cascade Range. Upon graduation, I went to work for the Gravity Meter Exploration Company in Houston and co-authored with L. L. Nettleton the first commercial test of the marine gravity system.

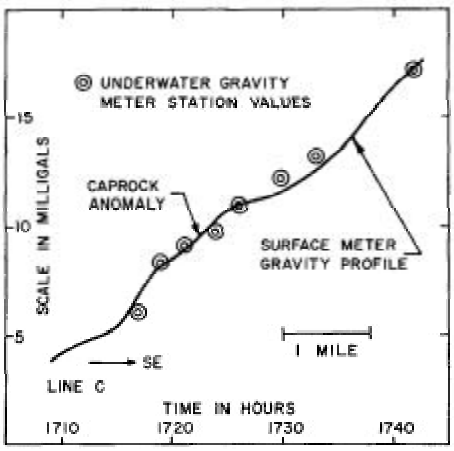
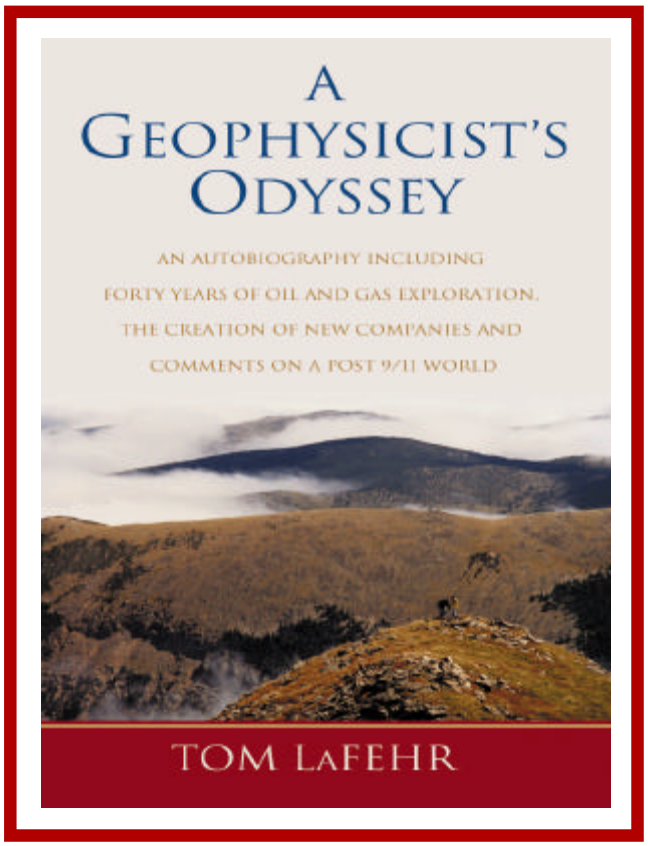


FIG. 4. Example of surface meter gravity profile and underwater control.

With this technical paper published in 1965, the onset of commercially acceptable marine gravity surveys began. Since then, millions of kilometers of marine gravity data have been acquired and processed. In 1969, I began my career as a professor at the Colorado School of Mines.

In addition to serving as professor, George Brown Professor, and Adjunct Professor at Mines, I founded EDCON in 1970, LCT in 1987, and was Chairman of the Board of LaCoste and Romberg-Scintrex in 2001-2002. I have also been active in the Society of Exploration Geophysicists, serving as editor of GEOPHYSICS (1972-3) and President (1983-4).

My current volunteer work at CSM keeps me active in gravity and magnetics through my work with Professors Yaoguo Li and Misac Nabighian. I am currently finishing a book entitled, "A Geophysicist's Odyssey."



In the left photo, Tom is carrying the LaCoste and Romberg gravity meter to the top of Mt. Shasta in Northern California as a part of his PhD thesis. At right, Tom is pictured with his graduate students in Honey Lake, California.

Honors & Awards

Members of the CSM Geophysics Department received a variety of honors and awards this past year.

Research Associate Professor **Mike Batzle**, Fluids in Rocks ("Center for Rock Abuse"), was awarded the 2002 SEG Virgil Kauffman Gold Medal for important contributions to rock physics.

Research Associate **John Stockwell**, Center for Wave Phenomena (CWP), received the SEG Special Commendation Award for the development, maintenance and support of the Seismic Unix (SU) processing system, an 'instant seismic software environment' that CWP has provided free to the public for over ten years. To date, SU has been downloaded to more than 3000 sites in almost 60 countries.

Professor **Tom Davis**, Reservoir Characterization Project (RCP), received the "Multi Component Technology Pioneer" Award from the geophysical service company, Input/Output.

Professor Emeritus **J. Edward White** was recognized with an Honorary Membership by the Chinese Geophysical Society.

Professor Emeritus **Norm Bleistein**, was appointed as Guest Professor to the Geophysics Department of the China University of Geosciences (Wuhan). Norm has been requested to lead the development of a stronger applied mathematical presence within the department.

Mike Batzle displays the SEG Virgil Kauffman Gold Medal with Department Head Terry Young.

John Stockwell with the SEG Special Commendation Award in recognition of his Seismic Unix work.

GP Professors Tom Davis (left) and Ilya Tsvankin during the Geophysics luncheon at the 2002 SEG, where Tom received the Multi Component Technology Pioneer Award from Input/Output.

Above: Norm Bleistein was honored Fall 2002 as Guest Professor by President Wang Yanxin of the China University of Geosciences (Wuhan).

Left: CSM President John Trefny (right) was on hand in October to congratulate Ed White during a reception held by the Department in Ed's honor.

In Memoriam

J. Edward White

1918-2003

Professor Emeritus of Geophysics, Dr. James Edward (Ed) White died January 30, 2003. Ed White was a greatly respected and accomplished scientist both in the geophysics industry and in academia.

At Colorado School of Mines, Dr. White was the first occupant of the Charles Henry Green Chair of Exploration Geophysics, a position he held from 1976 to 1988.

As an educator at CSM, he received the Halliburton Award for outstanding teaching and scholarship. He was known for his ability to communicate difficult concepts, deriving special joy from devising models to illustrate them. Many of his former students are renowned geophysicists in their own right in countries around the globe.

Ed was born in Cherokee, Texas, May 10, 1918. He graduated as valedictorian from high school in Fredericksburg, Texas. He received a B.A. and M.A. in physics with honors from the University of Texas-Austin in 1940 and 1946, respectively. He married Courtenay Brumby in Houston, February 1, 1941.

During World War II, J. E. White was the director of the Underwater Sound Laboratory of the U.S. Naval Research Center at Massachusetts Institute of Technology (MIT). He received his Ph.D. in physics from MIT in 1949.

He joined Magnolia-Mobil laboratories, Dallas, as Supervisor of Geophysics Field Research (1949-1955). Dr. White and his family lived in Littleton, Colorado, from 1955 to 1969 where he was one of the founders of Marathon Research Center (originally Ohio Oil Company). During thirty years of research for Mobil and Marathon oil companies, Dr. White made seminal contributions to four areas of seismic prospecting that are increasingly used and valued today: shear-wave prospecting, vertical seismic profiling, full-waveform acoustic logging, and attenuation of seismic waves.

J.E. White was one of the first American geophysicists to visit Russia, establishing and fostering close and enduring ties with the Russian geophysical community. In 1965, Dr. White, as a member of a six-man delegation sponsored by the U.S. Department of State, surveyed the status of geophysical exploration in the Soviet Union. He traveled to the Soviet Union in 1971 and then spent an academic year (1973-74) as part of an exchange program between the U.S. National Academy of Sciences and the Soviet Academy of Sciences. While in Moscow at the Institute of Physics of the Earth, he was able to visit centers of applied geophysical research throughout the Soviet Union.

In 1968, as President of the Society of Exploration Geophysicists (SEG), Ed encouraged the global expansion of geophysical societies and encouraged international collaborations. In 1981, geophysicists from the United States and from China jointly chaired a conference in Beijing. Ed was one of forty geophysicists who spent three weeks visiting geophysicists across China. As in his trips to the Soviet Union, Ed made a point of asking to see geophysicists who had not been heard from during the difficult years of the cultural revolution. He was honored to acknowledge those individuals and their contributions.

In 1987, Dr. White was selected by the National Academy of Engineering to conduct a month-long evaluation of the academic program of Changchun College of Geology in Jilin Province of Manchuria. Impressed with the quality of the students and especially their competency in mathematics, Ed enjoyed teaching two intensive courses there. His collaborations and those of many others resulted in increased exchange of faculty and students between the U.S. and China.

In addition to accomplishments in industry, Dr. White achieved international recognition in academic circles. Prior to his appointment at CSM, he was Lloyd Nelson Professor at the University of Texas in El Paso from 1973 to 1976. He was also a visiting professor at the University of Texas-Austin, MIT, and the University of Sydney, Australia.

He authored several textbooks that have been widely used and recognized. He published dozens of papers and was issued over twenty patents. In 2000, SEG published *Seismic Waves: Collected Works of J.E. White*.

Among his many awards and recognitions, he received the prestigious Maurice Ewing Gold Medal from the SEG in 1986 and in 1989, he was elected to the National Academy of Engineering.

He is survived by this wife, Courtenay, four children and seven grandchildren.

Memorial Contributions

may be made to the

J.E. White Memorial Scholarship Fund

Department of Geophysics,
Colorado School of Mines
Golden, CO 80401-1887

In Appreciation

At the risk of inadvertently omitting someone, we attempt to portray below the wide range of contributions the Department of Geophysics has received in the past year. The economic downturn has affected all of us significantly, and we are very grateful for your ongoing support!

THANK YOU!

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Please see the sponsors listed on the web pages for these projects: http://www.mines.edu/academic/geophysics/resources.html

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- Fluids in Rocks
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- Dr. Kenneth L. Larner

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- Dr. Ilya Tsvankin
- Mark T. Young
- Samuel J. Dennis
- Michael C. Mueller (with BP match)
- Vicki L. Hayden-Furey
- Dr. Norm Bleistein & Dr. Judy Armstrong
- Dr. Stan Lee (with ExxonMobil match)

Hasbrouck Geophysics Fund Lecture Series

- Alumni, Friends & Family of Bill Hasbrouck

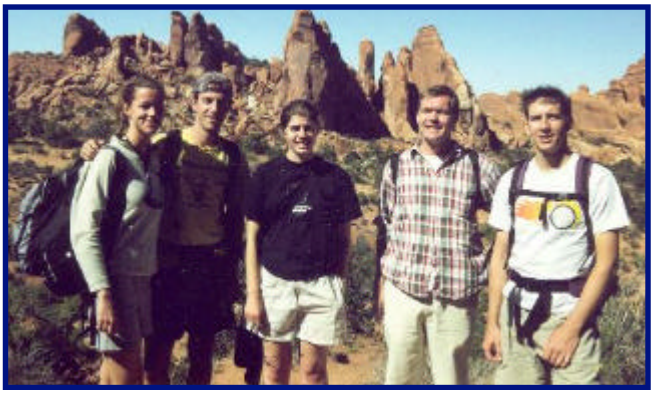
geophysics
COMINGS & GOINGS

Professor Sergey Goldin, Director of the Institute of Geophysics, Siberian Division of the Russian Academy of Sciences, in Novosibirsk, spent the first of several visits with collaborator CWP Professor Martijn de Hoop under a two-year grant from the U.S. Civilian Research and Development Foundation (CRDF). Here he entertains on his mandolin during a pizza lunch.

Graduate students Alex Grêt (left) and Kasper van Wijk (right) entertained guest Bart van Tiggelen (center), Director, Laboratoire de Physique et Modélisation de Milieux Condensés at CNRS/University Joseph Fourier-Grenoble. Their idea of entertainment was to make Bart cycle to the top of Lookout Mountain, Golden.

CSM Professor Ilya Tsvankin (right) and Michael Schoenberg, Lawrence Berkeley Lab, become part of the scenery atop Zugspitz, Germany's highest mountain, during a break in the program at the 10th International Workshop in Seismic Anisotropy (IWSA) in Tutzing, Germany, April 2002.

Among the students who visited campus last summer from across the United States to participate in CSM's Minority Engineering Program, this group shown with Department Head Terry Young chose to do a research project interpreting satellite data and calibrating their interpretation with geological field work.



A large contingent of faculty and students attended the 2002 Annual International Meeting of the SEG in Utah last fall. This group of grad students were among those who couldn't resist stopping at Arches National Park for some hiking: (left to right) Ludmila Adam, Kasper van Wijk, Alison Malcolm, Xander Campman (visiting CSM from Delft University of Technology) and Brian Zadler.

Among a full schedule of excellent speakers for the Department's weekly Carl Heiland Lecture Series was 2002 SEG President Walt Lynn.

THE TRIP

From industry to academia – and back again

— by Lesley W. Evans

While sitting in my office at the Denver Tech Center, I have a great view of the T-Rex highway construction and its associated traffic snarls. Not much time has passed since spending a semester as an "on-loan" visiting associate professor at the Colorado School of Mines, but it seems to be eons past. I am back to the high-paced work environment at Schlumberger Oilfield Services, where I am a principal geoscientist. I am honored to share my experience with you.

Visiting Associate Professor Lesley Evans.

I am a geologist who loves hiking and downhill skiing. I came to Colorado to pursue a master's degree and to work on my skiing—and I accomplished them both. I began my professional career as an exploitation geologist with Amoco Production, working southwestern Wyoming. While southwestern Wyoming doesn't sound exciting or really look exciting to many, its subsurface is home to many of the world's most challenging reservoir characterization problems. I am married to a Mines geophysical engineering graduate and we are raising five children, including twin daughters. If my technical career isn't challenging enough, personal challenges abound being a wife, mother, and stepmom! I am working on my MBA through an in-company program at Erasmus University in Rotterdam, The Netherlands.

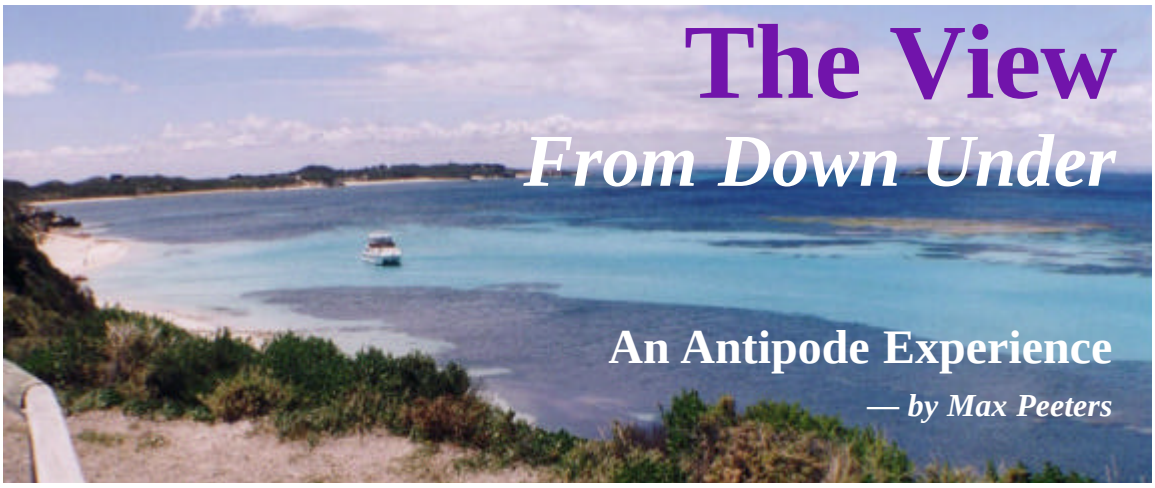
Here are some statistics that might partly explain why I came to Mines. Only 6 1/2% of science and engineering faculty in the United States are women. While 56% of university entrants are women, only 9% choose to follow engineering and science majors. The most powerful way to turn this demographic around is to build a base of qualified female science and engineering faculty to serve as role models to women entering the sciences. Last semester, Max Peeters taught in Perth, Australia, at Curtin University and asked me to teach at Mines while he was away. Schlumberger, an oilfield technology company, has programs to target and retain qualified women in its workplace. Schlumberger's dedication to promoting engineering and science careers to women, and the Department's desire for a female role model were in line with one another, and Schlumberger approved my transfer to Mines.

The high point was most definitely the interaction with my students. I taught a senior-level petrophysics class, which, for most students, is their first foray into the world of formation evaluation using open-hole log and core data. Since attending Amoco's Petrophysics Training Program in 1996/1997, I have wished to share the skills I learned there. Specifically, I enjoy integrating many sources of data to characterize the interaction between rock, pore and fluid systems. Creating my lectures was a time-consuming challenge. Targeting the correct level of information and relating the information using real-world examples was also challenging, but also very rewarding. Even though I am not that "old" it was good for me to to relate to college-aged students. I realized I was old in comparison when some of my jokes passed by them, like my subtle but magnificent, "Anyone? Bueller? Bueller?" after being met with sleepy silence to one of my questions in class.

My experience with the Women in Geophysics (WIG) mentoring program has led me to understand the importance of mentoring relationships and positive role models. I will miss the great coffee at "Higher Grounds" in Golden, the scenery and spending time outside, even if it was only to walk between the Department and my classroom. The faculty and staff were gracious hosts and hostesses. I liked seeing, feeling and smelling autumn arrive on campus, and it felt great to see the graduate student I supervised defend her master's thesis successfully. My teaching experience at the Colorado School of Mines was a great honor.

I thank Department Head Terry Young and Schlumberger's managers for allowing me this opportunity.

During her stint at Mines, Lesley organized a visit and demonstration by this Schlumberger wireline truck and its crew, parked here in front of the Green Center on campus.



The View
From Down Under

An Antipode Experience

— by Max Peeters

The Curtin University of Technology in Perth, Western Australia, has a very active geophysics department, where I spent the Fall 2002 semester as visiting professor.

Western Australia has a very pleasant climate, the magnificent Indian Ocean with coral reefs and an easygoing population. After 25 years since our last visit, my wife and I still have a few good friends in Perth, and we found a great house with a palm-ringed swimming pool, five minutes from the beach.

During this four-month period, I participated in the teaching of reservoir characterization and general geophysics courses, for which I provided the basic formation evaluation sections. Moreover, for the graduate students, I gave a short course on advanced formation evaluation.

I presented the keynote address for the Formation Evaluation portion of the Western Australia Basin Symposium (WABS), attended by more than 600 people. In addition I also gave two talks for the Formation Evaluation Society of Western Australia (FESWA).

Fortunately, we were able to make a trip North (toward the the sun!) to visit the Nigaloo reef, the dolphins at Monki Mia Beach, and the coasts where several Dutch Indies ships foundered, including the infamous ship the "Batavia." Western Australia has the distinction of possessing the "oldest" landscape on earth. In the Pilbara, hardly anything has changed for 2 billion years, except for an accumulation of dust, similar to the moon. They also have a "living fossil" (the Blue green algae), which has survived in very salty coastal inlets for the same amount of time.

During my absence, Lesley Evans (Principal Geoscientist with Schlumberger Data and Consulting Services in Denver) took over my duties as associate professor, serving as a long-needed faculty role model for our female students, albeit temporarily. (See article on the preceding page.)

I thank all the persons who made this prolonged visit possible: Mr. Andrew Gould, Schlumberger; my department head, Terry Young; and Curtin's geophysics department head, Norm Uren, as well as office manager Deidre Hollingsworth and computer manager Robert Ver-

Shown at top, Rotnest (named "Ratten nest" after the small Quaka kangaroos by Dutch explorer Roger De Vlaminck), twenty miles offshore from Perth.

At right, Curtin University Physiology building.

Home again: Max (standing left) recently received a technology transfer award from CSM in appreciation for his research and entrepreneurial efforts in developing a new patented technology, "Method for Measuring Reservoir Permeability Using Slow Compressional Waves."
Pictured presenting the award is Dr. Rahmat Shoureshi, CSM Director of Technology Transfer.

Environmental Studies of Earth & Mars

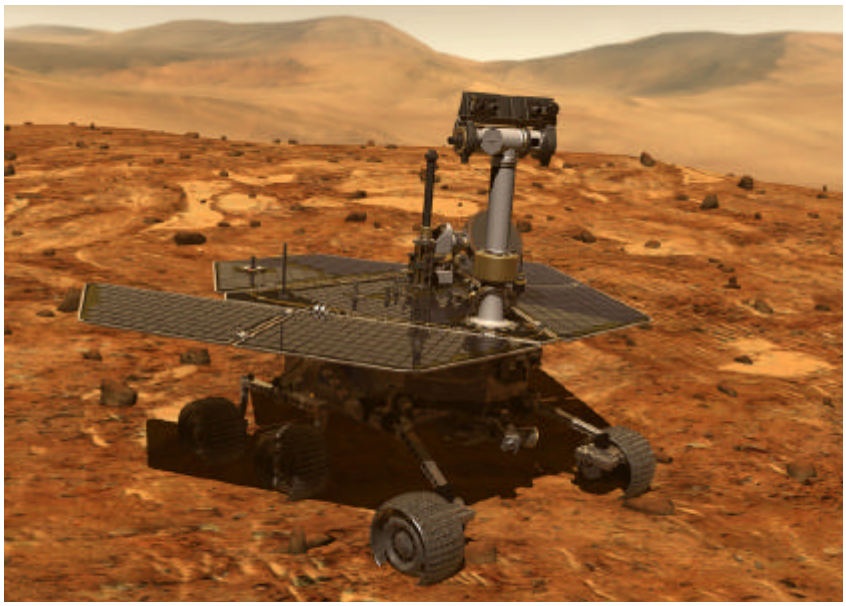
In Professor Gary Olhoeft's labs, Kate McKinley has just completed her MSc thesis studying the use of nonlinear complex resistivity (NLCR) to characterize and map dense NonAqueous Phase Liquids (DNAPL). One of the most common industrial contaminants, perchloroethylene or PCE, was found to react with smectite clays from the U.S. Department of Energy's Savannah River Technology Center in South Carolina.

Using laboratory and field instrumentation and software designed and built by Professor Gary Olhoeft, and working jointly with Dr. Robert Grimm of Blackhawk Geoservices Inc., with funding from DOE, Kate showed that PCE could be detected with NLCR at the fractional part per million level in the laboratory.

The team then conducted hole-to-hole NLCR measurements in the field at Savannah River, demonstrating that PCE could also be detected and mapped in 3D in the vadose zone at the ppm level. Innovative unsaturated zone borehole electrodes were developed for *in situ* emplacement for long term monitoring. The measured parameters included resistivity and phase, along with standard deviation error estimates and signal-to-noise measures for quality assessment, and full reciprocals, Hilbert distortion and total harmonic distortion measures of nonlinearity—all measured as a function of frequency from 0.001 Hz to 1,000 Hz in both the lab and the field. Standard 3D linear inversion and imaging algorithms were used to process and interpret the data, and extended to handle the nonlinear Hilbert distortion indicators. Further work is required to fully exploit the nonlinear information inherent in the data and descriptive of the clay-organic chemical processes.

Nonlinear complex resistivity mapping of part per million DNAPL at a challenging site: the source came from the outfall at the lower left of the picture, flowing through the trees at the center (where the electrode arrays bracket the flow path). Lots of plumbing, overhead and underground powerlines, vacuum extraction system to the left, sewage treatment plant to the right, power substation in the middle, road and railroad tracks behind the photographer, and a tank farm with cathodic protection just off to the left. The NLCR equipment is in the blue GMC Suburban to the right.

A world away, Gary has just been awarded a three-year NASA contract to study the impact of magnetic minerals (the "red" color) on the use of electromagnetic instruments to search for water on Mars. He gave an invited keynote address to the Conference on the Geophysical Detection of Subsurface Water on Mars in Houston, August 2001, "Subsurface geophysical detection methods to uniquely locate water on Mars."



Mars photo used with permission from NASA.

Gary Ohloeft was voted Outstanding Professor of Geophysics by the Graduating Class of 2002. Congratulations!

CO_2 Sequestration Research of Global Importance

– by Robert Benson
Associate Research Professor

Researchers from the Reservoir Characterization Project (RCP) are among those at CSM who have been working on the geologic sequestration of carbon dioxide (CO_2) in depleted oil and gas formations. Because it is one of the greenhouse gases that may affect global climate change, the storage of CO_2 is important.

The research goal to evaluate the feasibility of safe, long-term, and economical sequestration of CO_2 requires the development of advanced monitoring techniques to assess the CO_2 storage capacity, stability, rate of leakage, and permanence.

This research is part of a larger project funded by the U.S. Department of Energy (DOE) and the National Energy Technology Laboratory (NETL), entitled "Sequestration of CO_2 in a Depleted Oil Reservoir: A Comprehensive Modeling and Site Monitoring Project."

Other research partners include Sandia National Laboratories, Los Alamos National Laboratory, New Mexico Institute of Mining and Technology, Strata Production Company, and Kinder Morgan CO_2 Company.

The West Pearl Queen Field, which is located in the Permian Basin west of Hobbs, NM, was selected as the controlled test site where CO_2 would be directly injected into a depleted oil reservoir.

The Permian Queen formation reservoir is at a depth of 4500 feet. The productive sandstone interval has a net thickness of 25 feet, porosity of 18% and permeability of 5-30 md. The reservoir is interpreted as a structural dome with the CO_2 injection well, the Strata Stivason Federal #4, located on the apex of the structure.

Based on the research of RCP's previous CO_2 Enhanced Oil Recovery (EOR) monitoring projects at Vacuum and Weyburn fields, it was decided that 3-D, 9-C seismic data would provide the most conclusive results.

Top of page: View of the West Pearl Queen Field and the recording instrument trucks during the December 2002 seismic data acquisition. *Above:* The Industrial Vehicles International, Inc. "TRI-AX" 3-C vibrator used during the seismic acquisition. This vibrator generates three directions of motion that propagate into the ground.

3-D, 9-C seismology involves seismic data acquisition in three orientations at each receiver location—two orthogonal horizontal and one vertical. When three source components are used, nine times the amount of data of a conventional P-wave 3-D survey are recorded. The horizontal components of the sources and receivers enable shear- (S-) wave recording. These surveys provide significantly more information about the rock/fluid properties of a reservoir than conventional P-wave seismic data.

The program involves the repeated acquisition of a 3-D, 9-C seismic survey before and after a CO_2 injection process. Its purpose is to demonstrate the ability of repeated (time-lapse) 3-D, 9-C seismology to detect and monitor changes in rock/fluid properties associated with the CO_2 injection and "soak" process. Solid State Geophysical Inc. collected the initial 3-D, 9-C survey from December 3 to December 16, 2002. During the injection of the CO_2 that began on December 18 and lasted until February 11, 2003, approximately 10,000 tons of CO_2 were injected into the reservoir. The CO_2 "soak" period will extend until the repeat 3-D, 9-C seismic survey is collected, which is currently scheduled to begin during the first week of April 2003.

Fairfield Industries Inc. is processing the initial seismic survey, and CSM geophysics students Cristian Malaver and Tagir Galikeev will analyze the data.

Ultimately, the data will be used to predict storage capacity and the changes in reservoir properties. A better understanding of CO_2/reservoir interactions will also allow these technologies to be applied to CO_2 EOR projects, thus improving hydrocarbon recovery from reservoirs.

The ART of Science

New Summer Course

There is more to being a scientist than what you might learn from traditional texts and classes. It is the goal of a new non-conventional class at CSM to explore the multilayers of being a scientist not taught in most engineering classes.

Roel Snieder (W.M. Keck Foundation Distinguished Professor of Basic Exploration Science) has taught the interdepartmental course, "The Art of Science," for the past three semesters to CSM students, and it is becoming increasingly popular.

During the summer, a four-day version of the course will be offered for the first time as part of the school's continuing education program, aimed at participants from outside CSM.

The goal of the course is to give beginning researchers effective research skills. "Though the philosophy of science and ethics are briefly discussed," reports Snieder, "the emphasis is on practical aspects of doing science."

Course topics include defining goals and realizing them, making a work plan and executing it with a group, writing proposals, publishing papers, and the creativity of science.

To learn more about the course, e-mail Roel Snieder at rsnieder@mines.edu.

Roel Snieder works here with a group of students during The Art of Science course. The class is meeting in the new GP Department John C. Hollister Reading Room. Hollister was a '33 CSM grad and department head from 1949-72.

Professional Master's Degree Added to GP Offerings

The Geophysics Department is jointly administering a new program recently added to the CSM degree offerings. The Professional Master's in Petroleum Reservoir Systems (PMPRS) is a non-thesis, one-year, interdisciplinary program jointly administered by the departments of Geophysics, Geology and Geological Engineering, and Petroleum Engineering.

This program is open to qualified individuals with undergraduate degrees in geological, geophysical, petroleum, or related engineering disciplines.

PMPRS is designed to prepare professionals with knowledge and skills that span a wide range of disciplines in order to meet the growing management and development demands in the hydrocarbon resource industry.

The PMPRS degree program has the following advantages that may appeal to those already working in the industry: it is one-year in length; no thesis or research is required, the courses are team-taught and interdisciplinary; and the curriculum is individually-tailored.

If you would like to learn more about the Professional Master's Degree, please contact the CSM Graduate Studies office, (303) 273-3248, or Geophysics Department Head Terry Young, (303) 273-3454.

The New Viz Center

Integrating Visualization in the Classroom

– Michael Ewing, Graduate Student

For years now, petroleum-oriented education and research at the Colorado School of Mines have been a team effort among the Geology, Geophysics, and Petroleum Engineering departments. In both undergraduate and graduate courses, students have been organized into multi-disciplinary teams to work on prospect generation and field development in the same manner as they would on asset teams in industry.

Thanks to the donation of a visualization center from Phillips Corporation (now ConocoPhillips), a new dimension has been added to multi-disciplinary education and research at Mines. Grad student Michael Ewing has taken the lead in organizing multi-departmental visualization activities that include not only the "geo" departments, but also the Department of Mathematical and Computer Sciences. An early spin-off from this collaboration was a short project that Michael did in medical imaging. Since Michael earned his B.Sc. in geophysical engineering at Mines before enrolling as a graduate student, he sees the Viz Center as introducing a new teaching paradigm. Below is how he describes the change.

The figure is taken from the brochure advertising the new Professional Master's Degree in Petroleum Reservoir Systems, another program that will benefit from the new Viz Center.

The Viz Center, disguised as a seemingly normal classroom, allows for a blending of three styles of teaching: from the classic era, there are lectures with chalkboards and overheads; from the modern era, there are business presentations and video content; from the future era, there is 3D interactive data display and modeling.

Imagine trying to teach someone about the intricacies of migrating seismic data. The mathematics can be covered in a classic style lecture. The effects can be shown in a modern style presentation. However, what if you really wanted to engulf the students in the process? What if you wanted to show them a 3D dataset and allow them to modify parameters on the fly? Rather than giving students software and a lab assignment and few words of encouragement, this could all be done inside the normal lecture using an interactive 3D display system.

Imagine another scenario involving a group of petroleum engineers, geologists, and geophysicists. Normally the processing of seismic data would be partitioned off as a focus for the geophysicists. They would do their duty and then report their findings back to the group. Trouble strikes when there is uncertainty—what if the geophysical model doesn't match the geologic cross-sections or the well logs? This problem is solved easily by having an interactive data environment: simply bring the entire group into the Viz Center and process the data collaboratively.

Perhaps a graduate student would like to show a model or process to his committee. As ideas are generated among the members of the group, they can be tested. The need to take notes and to meet again later to discuss findings are reduced. Again a collaborative effort gives students a better training for industry and saves everyone time.

The Viz Center incorporates a FakeSpace concave projection screen and high-resolution projector with an SGI Octane and PC Pentium 4. The SGI is equipped with software from Landmark, GoCAD, and Phillips. The PC is equipped with 3DS Max and programming suites to gain access to the NVIDIA G-Force 4 power inside it. The system also has hookups for DVD, VHS, and laptops.

The past, present, and future all merge in a single environment—a new style of teaching and a new style of learning—welcome to the new Visualization Center.

Graduation 2002

Congratulations May 2002 Undergraduates!

Back Row: Monica Arancibia, Joe MacGregor, John Hunyadi, Misti Williams, Shawna Leavitt & Rachel Vest.
Front Row: Cambrey Johnston, Sarah Shearer, Jessica Semmler, Michael Ewing & Aniza Yaakob.
Not Pictured: Nicole Baert, Hadi Balhareth & Darcy Wardle.

Department of Geophysics 2002 Graduates

B.S. Degree

Monica Arancibia
Nicole Alana Baert
Hadi Mohammed Balhareth
Michael David Ewing
John Edward Hunyadi
Cambrey Shirell Johnston
Shawna M. Leavitt
Joseph Andrew MacGregor
Jessica Jill Semmler
Sarah Elizabeth Shearer
Rachel Elaine Vest
Darcy Kathleen Wardle
Misti Chantel Williams
Aniza Yaakob

M.S. and M.E. Degrees

Leo Thomas Brown
Philip J. Brown II
Valmore Tomas Franco Celis
Ida Herawati
Ernest A. Hull
Ryan E. North
Christopher M. Sneddon
M. Syafiul Umam
Travis Cress Wilson

Ph.D. Degree

Reynaldo Cardona
Petr Jílek
Kristen Anne Lewis

2002 Graduation

Master of Ceremonies: Terry Young

Petr Jílek

Kristen Lewis

Hadi Balhareth

Rachel Vest and Shawna Leavitt

Phil Brown with wife Motoko, and twin sons Shotaro and Kentaro.

Honoring alumni from the Class of 1952.

Reynaldo Cardona and wife Silvana.

*Faculty*Bootcamp

In an attempt to know as much as their students, GP faculty gathered for a five-session class in August for basic training in the Java and Python languages, taught by Tom Boyd and John Scales. Graduation awards included a Java T-shirt and a cup of the real stuff to go with it. Those pictured here are (back row): Phil Romig (Head of Graduate Studies & Research), Terry Young (Department Head), Tom Boyd, Ken Larner & Yaoguo Li. Front row: Bob Benson, Roel Snieder, Gary Olhoeft, & John Scales. Not present for the photo was Misac Nabighian.

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