

geophysics

Colorado School of Mines

Spring 2007



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The Cover

Undergraduates studying the flow field on Kilauea, Hawaii. Read the story on page 26.



From the Department Head

Dear Reader,

I hope you enjoy this newsletter of the Department of Geophysics at Colorado School of Mines. There are many exciting things going on in the department, and our aim is to give you a taste through the photographs and articles we've published here.



Terry & Nadine Young
GP 'Welcome' Barbeque
Fall 2006

Our undergraduate enrollment has grown 50% since 2000, and the hot demand for geophysicists in the job market means that our students are faced with the enviable problem of choosing among multiple job offers, both for summer internships and permanent employment.

This year we welcome Mike Batzle to a new role on the faculty. Mike was selected to succeed Max Peeters as Baker Hughes Professor of Petrophysics and Borehole Geophysics. We also welcome newcomer André

Revil to our faculty. André adds breadth to CSM with his applications of electrical and EM methods in various contexts such as oil and gas reservoirs, hydrogeophysics, geothermal fields and volcanoes. Searches for two other new faculty members are nearing completion, so stay tuned to find out who else will be joining the department!

Geophysics facilities in the Green Center are undergoing a much anticipated renovation, both in the basement (or garden level, as Mike Batzle prefers to call it) and on the second floor. The State of Colorado allocated \$3.4 million to upgrade HVAC and instructional labs in the basement and to do recarpeting and other cosmetic improvements on the second floor. As the Academic Computing and Networking facilities move from the Green Center to the new wing in the CTLM building, a lot of folks around campus are vying to become our new floormates. Because the remaining service life of the Green Center roof is anticipated to be only another seven years or so, we continue to hope that the current embarrassment of riches faced by some of the companies who sponsor our research and hire our students will compel them to endow a new facility for future generations of geophysics students.

This is a good place to remind alumni readers that we host a luncheon on graduation day both in December and in May to honor not only our graduating students and their guests, but also our returning alumni and their guests. We sincerely hope you will join us for one of these festive gatherings!

With warm regards,

A handwritten signature in black ink, which appears to be "Terry".

CSM Geophysicists Honored at 2006 SEG Meeting



Presidential Address

Terry Young Proposes Expanded Directions for SEG



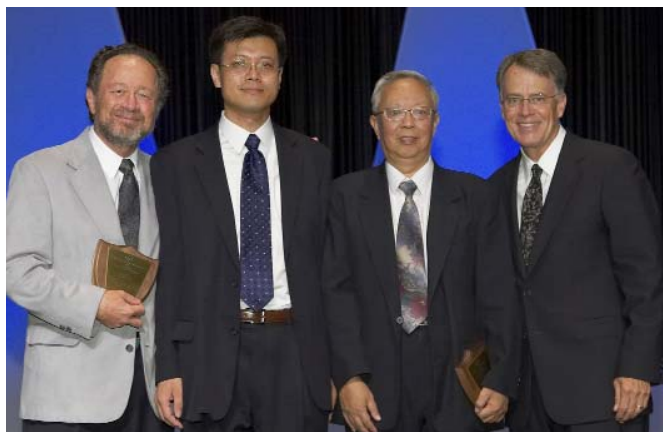
Winding up his term as SEG President, Terry Young concluded the 2006 Honors and Awards ceremony with the talk, “Our expanding sphere—grand challenges for planet Earth and for SEG.”

Young spoke of the global challenges faced by the planet and the opportunity these challenges present for applied geophysics to expand its focus beyond that of exploration for, and development of, oil and gas resources:

“ The field of geophysics is exciting because of its breadth of applications and opportunities for impact on this planet and beyond. The range of possibilities for geophysics to contribute to the major challenges of our day and for generations to come is far beyond what most of us generally think. Some possible beneficial applications of geophysics don’t have an obvious commercial angle, and so they are unlikely to occur unless someone has the vision and passion to make them happen. Other applications depend for success on effective collaboration with other scientific disciplines.

It is a pleasure to educate new students in a field that is so rich with possibilities!”

Best Paper in GEOPHYSICS in 2005



Norm Bleistein, CSM University Emeritus Professor, was presented SEG’s Best Paper in GEOPHYSICS Award, along with his co-authors Yu Zhang (CGGVeritas) and Guanquan Zhang (Chinese Academy of Sciences), for the paper, “Theory of true-amplitude one-way wave equations and true-amplitude common-shot migration.” They are shown here at the Honors and Awards Ceremony with SEG President Terry Young. In addition, Norm’s presentation at the 2006 meeting in New Orleans, “Kirchhoff inversion for incident waves synthesized from common-shot data gathers,” was ranked among the Top 30 papers presented.

Best Student Poster Paper at 2005 Annual Meeting



Yaping Zhu, 2006 PhD graduate, received the Best Student Poster Paper Award for his presentation at the 2005 SEG meeting titled “Plane-wave attenuation anisotropy in orthorhombic media.” This paper was co-authored by his thesis advisor, Ilya Tsvankin. In addition, this paper was among those selected as one of the Top 25 papers at the SEG 2005 meeting in Houston. Yaping is employed by ExxonMobil Upstream Research Company.

Best Student Oral Paper at 2005 Annual Meeting



Kristopher Davis received the Best Student Paper Award for his presentation at the 2005 SEG meeting titled “Automatic detection of UXO magnetic anomalies using extended Euler deconvolution.” This paper, submitted while an undergraduate, was co-authored with professors Yaoguo Li and Misac Nabighian. This paper also ranked in the top 25 papers presented at the Houston meeting. Kris continues at CSM as a PhD student.

André Revil to Join GP Faculty

The GP Department is pleased to announce the addition of André Revil as associate professor of geophysics, beginning August 2007. André is currently working with the CNRS (Centre National de la Recherche Scientifique) in Aix en Provence, France, where he is head of the research team for hydrogeophysics and porous media at CEREGE.

He received a degree in engineering from the IPG of Strasbourg in 1993 and a PhD in 1995. He then spent two years as a postdoctoral fellow at Cornell University working with Drs. L. M. Cathles and O. Brévar (Elf).

He is interested in the development of geoelectrical methods (including self-potential, electrical resistivity, and induced polarization),

combining his expertise in petrophysics and the development of new algorithms for forward and inverse modeling of geophysical data.

He is also interested in the application of these methods to a variety of problems including the contamination of aquifers, the determination of the hydraulic transmissivity of the ground, and applications of these geoelectrical properties to active volcanoes.

In 1999, he received a French Young Scientist Award (ACI-Jeune) from the Minister of Research and Education. In 2003, he received the Bronze Medal from CNRS for outstanding research activity. In 2004, the ARMA (American Rock Mechanics Association) honored André with an Award of Excellence for the paper

"Pervasive Pressure Solution Transfer in a Quartz Sand", JGR-Solid Earth, 106 (B5), 8665-8686, May 10th, 2001.

Regarding his plans for research and teaching at CSM, André says, "One of the challenges is to combine methods, so I will pay strong attention to joint inversion of electrical methods with seismic and potential field methods (gravity and magnetism) in collaboration with Drs. Li and Snieder. I plan to develop interactions with other departments, such as material sciences, hydrogeology, physics, and reservoir engineering, because my research is by nature multidisciplinary.

I plan to develop classes not only in hydrogeophysics but also at the interface of different disciplines. My teaching and my research incorporate both lab and field work."



Welcome to Brian Passerella

GP Laboratory and Field Coordinator



If you are familiar with the GP department's CSM "home" in the Green Center, you know of

the lower level maze where our labs are located. Among the jungle of field equipment (both outdated and current) and other instruments, order is about to be restored.

New staff member Brian Passerella recently joined the Department as Laboratory and Field Coordinator. Needless to say, he has been busy since his arrival.

Brian is a 2001 graduate from Metropolitan State College of Denver with a BS in biology and a minor in chemistry.

He was previously employed at the University of Colorado Health Sciences Center doing genetics research on Polycystic Kidney Disease genes. In that position he was also responsible for the setup, calibration, and maintenance of all the scientific equipment and instrumentation.

In spite of the many tasks ahead, Brian states, "I am excited about the opportunity to get into the field of geophysics. I am looking forward to many years ahead with CSM and the

Department of Geophysics. Judging by the "to do" list compiled for him, "many years" sounds likely.

Welcome, Brian.

GP Department Earns Diversity Award



GP students Xiaoxia Xu and Jyoti Behura.

On Martin Luther King's birthday this year the Department of Geophysics was awarded a plaque in recognition of its efforts on behalf of diversity by the Minority Engineering Program (MEP). The Department has long recognized that healthy diversity among both the geophysics faculty and the geophysics student body – undergraduates and graduate students alike – is a very important objective. Faculty members are role models. Students are more likely to discover geophysics for their major and for a career if they encounter faculty members with whom they can identify personally.

During recent and current faculty searches the Department of Geophysics has been working closely with CSM's Human Resources department to conduct searches in such a way as to improve the likelihood of hiring new faculty members, not only because they are stars in research and teaching, but also because they will enrich the department by making its faculty more diverse in gender and ethnic distribution.

The Minority Engineering Program (MEP) at Colorado School of Mines is a class act!! In recent years, the Department of Geophysics has endeavored to teach a module in the on-campus summer activities of MEP. This is a good way to attract high-potential students both to Mines and to Geophysics who will enrich the diversity of our campus culture. Ultimately, it would be a winning partnership for companies who hire our students to offer scholarships and fellowships especially in support of attracting minority students into the geosciences, where they are currently underrepresented. We would like to be able to offer financial assistance, in addition to a rewarding education, to interested students from different backgrounds throughout the U.S. and around the globe.

Prof. Max Peeters Celebrates Retirement

This past year Professor Max Peeters has been in a period known as transitional retirement. During Fall semester, Max and his wife Lilian toured the world and then during Spring semester he returned to his teaching duties. In theory Max will be retired as of July 2007. In reality, who knows?

Max has no plans to slow down anytime soon. In anticipation of his retirement he established himself in several important roles as a community volunteer. Undoubtedly the most visible of these is his appointment as the Honorary Consul of The Netherlands by Her Majesty Queen Beatrix. He also made plans to serve in a consulting ca-

capacity teaching short courses in industry. In addition, due to the high demand for additional faculty members in CSM's Petroleum Engineering Department, Prof. Peeters may lend his teaching services there. We probably shouldn't expect to see him out on the golf course anytime soon.



Max practices for retirement during one of his volunteer stints with Jefferson County Open Space.

Fast-track Degrees

Did you know that the Department of Geophysics encourages students to consider the possibility of moving seamlessly from the BS program in geophysical engineering directly into the MS program in either geophysics or geophysical engineering — a plan that saves time and money?



Don Keighley, MSc.

Some graduates are eager to go right to work, especially when the job market is as hot as it is currently. But for many undergraduates, it makes sense to take advantage of the savings in cost and time to move right through a combined undergraduate/graduate program.

Some employers prefer to hire entry-level employees with the MS rather than with the BS degree. The combined degree can also be an advantage for students who wish to do research or to take academic positions in disciplines where they will ultimately need a PhD – for example oceanography, glaciology, volcanology, or earthquake seismology.

To make the best use of credit hours and to streamline the progress toward a graduate degree, a student should apply for grad school during the junior year, allowing a faculty member to advise the most beneficial classes for both degree programs.

In this combined degree plan, the student may “double count” (use for both degrees) up to six hours from the undergraduate program, and the capstone senior design project can be used as a springboard into a research topic that could ultimately be turned into a thesis.

Mines Welcomes Geoscientist as 16th President

Myles W. (Bill) Scoggins, Ph.D., was appointed Mines' 16th president in June 2006, upon the retirement of John U. Trefny, who has been named president emeritus.

Dr. Scoggins retired as a senior executive of Exxon-Mobil Corporation in 2004 with more than 34 years experience in the global oil and gas business.

Geophysics Department



Head Terry Young says of Dr. Scoggins' initiation to Mines, "With his academic credentials as PhD in Petroleum Engineering, his industry background as a senior executive of ExxonMobil, and his university governance experience on the board of Tulsa University, Bill has quickly and effectively moved into high gear in his new role as president of CSM.

His warm interpersonal

style and jovial humor have struck a harmonious chord with folks on and off campus.

President Scoggins' business acumen will likely pay dividends for Mines as he faces the challenging decisions associated with running programs of excellence with a budget limited by austere funding from the State of Colorado."

A Wish (partially) Come True

For years there has been talk of renovating the Green Center, home of the Department of Geophysics. A succession of Visiting Committees and ABET examiners have weighed in with official pronouncements that renovation is needed. Finally, the State of Colorado has allocated \$3.4 million to solve some of the most pressing issues. Renovation activities will begin as soon as Spring semester ends in May 2007.



Improvements are especially needed in the basement (or, the "garden level" as some prefer to call it). Air piped into the basement is not adequately filtered, so that a layer of dirt is quickly deposited on table and desk surfaces, creating what seems more like an archeological site than a modern laboratory and classroom facility. Furthermore, the geophysics side of the garden level is not ADA compliant. Temperatures are sweltering in summer and freezing in winter, causing one graduating class to print a T-shirt proudly proclaiming "I survived [classroom] B-70!"

However limited the planned renovations are, it will be great to see some of the much-needed improvements finally occur. For now, we're grateful for new carpet and paint. Check back with us next fall.

Experiencing Post-Katrina

As with many other 2006 SEG Meeting participants in New Orleans, Ken and Nancy Lerner wanted to see some of the devastation that had been caused by the effects of Hurricane Katrina, but not merely as sight-seers.

They spent a day helping at a Habitat for Humanity site in the Upper Ninth Ward, where they worked with 'highly motivated' Americorps volunteers and Habitat people. Ken reports that the Habitat homes are small, but neat and nicely livable. They are up to new code, above the high-water level of 2005.

However, Ken says, "the number of Habitat homes are a drop in the bucket. In the area, there was not a previously existing home for many square blocks that was occupied or likely salvageable."

Ken and Nancy and other volunteers encountered genuine appreciation from people within the Upper Ninth Ward, and elsewhere in New Orleans, for any help that people might provide.



Ken Lerner lends a hand at a Habitat for Humanity house-raising in the Upper Ninth Ward.

Teaching the Art of Science

The Art of Science, a course taught by Professor Roel Snieder during spring semester, has drawn a record number of 47 graduate students from different departments across campus.

In this course, beginning graduate students learn basic practical skills that are important to have in an academic or an industrial research career. Topics that are covered include choosing a research topic (and an advisor!), tapping into your creativity and turning this into a work plan, publishing a paper, and setting goals. Other topics include the role of a process-oriented or meaning-oriented workstyle, time management, and communication. Snieder's (and his students') favorite class session is on oral communication, during which he demonstrates how *not* to give a presentation. In the next academic year, Snieder will finalize a book on the Art of Science with co-author Ken Lerner.

What students say about the Art of Science:

"This class not only talks about how to be a scientist, but also covers a lot of things that are basic to a person. These might be of great value to me."

"This course helped bring a complex system of coursework, life, goals, and scientific ideas together."

"I value this course because it teaches what every new graduate student should know. Thank you."



Dr. Roel Snieder

Emeritus Professor Maurice Major died February 26, 2007. Dr. Major was a much admired professor in the geophysics department from 1963-1985. He also had a long career with the USGS.

Learning of Dr. Major's death, his former student Bruce Presgrave (MSc, 1979) sent the following message to the Department and to colleagues at USGS where he is currently a supervisory geophysicist.

"Subject: Sad News about Dr. Maurice Major

For those of you who did not know Dr. Major, he was a Professor of Geophysics at the Colorado School of Mines and Director of the Cecil Green Geophysical Observatory in Bergen Park, one of the original stations of the old Worldwide Standard Seismograph Network stations. Maurice was in charge of the observatory during the swarm of induced earthquakes in "Derby" (now Commerce City, CO) during the 1960's. Like Waverly Person [of the USGS], Maurice had a talent for explaining geophysical processes in terms the public could understand, and he was chief spokesperson here in the Denver area during that swarm.

A good storyteller who never took himself too seriously, he participated in one of the earlier versions of ocean-bot-

In Memoriam Maurice W. Major



Dr. Major shown with CSM geophysics graduate student Jim Reeves (PhD 1984).

— photo, Department archives

seismometrics. He was principal investigator of a seismology project in the Aleutian Islands in the 1970's and while towing a seismometer to the island of Semisopochnoi, it was swamped by heavy seas and sank. While most people would have avoided discussing this unfortunate incident, Maurice carefully plotted the "deep-sixed" location on a large map in the Green Center that showed the rest of the network, then just waited for some innocent grad student to ask the question "Why is this station out in the middle of the channel?" His answer was always "That's our ocean-bottom seismometer" and proceed with enthusiasm to tell the story.

In 1973-74, he was instrumental in the National Earthquake Information Center moving to the School of Mines campus when it was transferred from NOAA to the USGS.

After retiring from CSM, Maurice became a "gentleman farmer" on the Eastern Plains of Colorado, north of Burlington.

It was my interview with him in 1973 that convinced me that CSM was where I wanted to do my graduate studies. Maurice was my advisor and friend. (And yes, I was one of the innocent grad students drawn in by his OBS)."

Dr. Mike Batzle



BAKER HUGHES PROFESSOR OF **PETROPHYSICS AND BOREHOLE GEOPHYSICS**

After an international search we discovered the best candidate for the Baker Chair down on the garden level of the Green Center. With Prof. Max Peeters in transition toward retirement we conducted an international search that yielded an outstanding pool of applicants for his position as Baker Hughes Distinguished Chair of Petrophysics and Borehole Geophysics. It didn't occur to us that we might end up selecting someone close to home. Looking back, it probably should have been no surprise that Mike Batzle emerged from the search as the top candidate.

Mike arrived at Mines over a decade ago. He is fond of describing his arrival in the context of good news / bad news: "the good news is that the company formerly known as ARCO donated a world-class rock physics lab to CSM; the bad news is that I came along with it." In spite of his valley-

girl vocabulary and preference to describe his research program as the Center for Rock Abuse, as a research faculty member Mike has become an invaluable contributor both to the Department of Geophysics and to the Mines community generally.

Exhibiting an enormous amount of energy, Prof. Batzle arrives in his lab before dawn and is constantly on the go. He characterizes his frequent travel as "begging for money" from industry to support his rock physics research program. Mike's research supports a large number of students – both grad students and undergrads. In addition, Mike teaches Field Methods and Senior Design. This year Mike also co-taught Borehole Geophysics with Max Peeters. Next year he expects to add Formation Evaluation. In case that is not enough, Mike also directs the department's geophysics field camp each summer.

He serves on a large number of graduate student thesis committees and is advisor to many students. Students love his easy-going, self-effacing style of teaching and his quick-witted humor.

In the lab, Professor Batzle and student preparing the Baker Chair?



Dr. Mike Batzle at the 2005 SEG International Meeting receiving the award for Best Poster Paper (2004), co-authored with De-hua Han. The award was presented by SEG President Craig Beasley .

In 2002, Prof. Batzle received well-deserved recognition from the Society of Exploration Geophysics when he was awarded the Virgil Kauffman Gold Medal for his outstanding contributions to the advancement of geophysical exploration. In August 2007, Mike assumes his new position as Baker Hughes Distinguished Chair of Petrophysics and Borehole Geophysics.



Stream Processing: A new frontier

Research professor teams with undergraduate

This collaboration is an example of research opportunities available to undergraduates in the GP program.

Seismic data processing is known to be one of the most computationally demanding scientific disciplines, due to the complexity of algorithms and large data volume. Recent trends toward 3D wide-azimuth data acquisition coupled with development of waveform inversion algorithms has the potential to further increase the computing needs by at least one order of magnitude relative to processing of more conventional seismic data.

Increases in computing needs have been traditionally offset by increasing speed of central processing units (CPU) governed by the well-known Moore's Law which states that CPU speed doubles every 18 months. However, the performance increases of conventional processors have been leveling out in recent years and computing speed-up has been sought through multiple "cores" for parallel processing inside CPUs.

A complementary processing paradigm is stream computing where computations are made on a processing unit designed to perform fast parallel operations on large datasets. Examples of such processing devices are Graphics Processing Units (GPU), which are universally present on the

graphics cards of personal computers. As their name suggests, GPUs have been traditionally employed for rendering graphics on computer screens and their rapid development over past decades was mainly driven by graphics-intensive applications (e.g. computer games). Capitalizing on their computing performance, GPUs have been recently suggested as alternative processing devices for seismic data.

GP undergraduate student Trevor Irons, and GP faculty member Paul Sava are currently involved in a project whose goal is to investigate the potential of applying stream processing to seismic data and to create prototype software demonstrating the features of this type of computing. The project uses open-source computer code developed by the Center for Wave Phenomena (CWP) as part of the Madagascar software project (see <http://rsf.sourceforge.net>) and is a collaboration with PeakStream Inc., a California-based company specialized in developing software for streaming processors.

Initial results look promising: computing speed on standard benchmarks developed by GP faculty member Dave

Hale shows increases of up to 40 times over conventional CPUs, while more practical seismic modeling applications show increases of approximately one order of magnitude with further improvements expected.

Stream processing is not a panacea for all processing needs. In order to realize these gains a compromise of flexibility for performance must be made. The largest gains are on exceedingly parallel and numerous tasks, which fit many but not all computing needs of seismic data processing.

The project has been a great learning experience for Trevor who has been introduced to high performance computing and has gained valuable programming experience. The novelty of this project also positions the CSM Geophysics Department among the few academic groups operating at the current frontiers of computing technology. Several of CWP's industrial sponsors have expressed interest in the outcome of this project.



Professor Paul Sava and GP Senior Trevor Irons

Brainpower for Research Postdoctoral Fellows

During 2006-2007 the Department has had three postdocs onboard. We asked this group to describe their projects at CSM.



Masatoshi Miyazawa, Assistant Professor
Disaster Prevention Research Institute (DPRI), Kyoto University, Japan,

Monitoring microseismicity in a heavy-oil reservoir during steam injections

While at CSM, I collaborated with Roel Snieder on an ExxonMobil project involving induced seismicity due to successive steam injections into a heavy-oil reservoir. This short stay was very fruitful for me, both academically and personally.

For the first several months I struggled with the huge amount of continuous seismic data (2 TB) to see how seismic event signals look. The powerful CWP cluster computer scanned the data and, as a result, we could precisely locate induced micro-earthquakes, which were explained by a geomechanical model. We also used

the other part of the data: noise. By applying seismic interferometry, we could successfully detect signal propagations from surface to bottom and anisotropic structures. Active discussion with faculty and students on this project and on other topics was scientifically exciting.

The peaceful atmosphere of the city of Golden and the nearby mountains suited me, especially during the winter, when I amused myself with alpine and telemark skiing. The scenic areas leading to the Rocky Mountains were my favorite walking, cycling, and driving sites. I enjoyed my stay at Colorado School of Mines, and I would like to express my gratitude to all the people in the Department.

Masatoshi received a PhD in geophysics from Kyoto University in 2003, where he was a research fellow of the Japan Society for the Promotion of Science (JSPS). As a postdoctoral researcher in DPRI from 2003-2005, he was engaged in seismic observations and analyses. In 2005, he performed joint research with seismologists at both Caltech and UCLA. His research includes earthquake triggering, low-frequency seismic events, simulation of scattered seismic wavefields, seismic tomography methods, and seismic hazards.



Laxmidhar Behera, Scientist
National Geophysical Research Institute (NGRI)
Hyderabad, India

Migration velocity analysis for tilted TI media

My visit was supported by the BOYSCAST Fellowship from the Department of Science and Technology (DST) of the government of India. My research project with Ilya Tsvankin was devoted to migration velocity analysis (MVA) for tilted transversely isotropic (TTI) media.

By incorporating the tilt of the symmetry axis into the MVA method of Sarkar and Tsvankin, we obtained significant improvements in image quality compared to the best VTI result for different geologically plausible TTI models. Our results illustrated the su-

perior quality of the TTI image for a model that includes a bending TI shale layer with the symmetry axis orthogonal to the layer boundaries. The sections were obtained using Kirchhoff prestack depth migration. I am also involved in other projects, including tomography and 3D MVA analysis.

I truly liked the interaction with students, faculty and staff members in the Department of Geophysics. During my stay, I enjoyed hiking in the Rocky Mountains, and the snow in Golden really appealed to me. CSM is a cool place to do good research.

Laxmidhar received an M.Sc. Tech. degree in applied geophysics from the Indian School of Mines (ISM), Dhanbad, in 1995 and was awarded the Dr. Harinarayan Medal from the Mining, Geological and Metallurgical Institute of India for securing first rank in applied geophysics. He joined a multinational oil company as a geophysicist for two years, then joined the NGRI seismic group for research. In 2003, he earned his PhD in geophysics from Osmania University and was also honored by the ONGC-AEG Best PhD Thesis Award, for his thesis, "Seismic imaging of Mahanadi Delta, India."

Postdoctoral Fellows



Rich Krahenbuhl

Center for Gravity, Electrical & Magnetic Studies (CGEM)
CSM Ph.D., Geophysics, 2005

As a geophysics postdoc in the Center for Gravity, Electrical & Magnetic Studies (CGEM), my primary work is to perform and publish research, write proposals, and teach undergraduate and graduate courses.

Research Projects

There are several research projects that I am currently associated with through CGEM. The first is bringing closure to a three-year research project funded through SERDP on improving detection and discrimination of unexploded military ordnance (UXO) in strong magnetic environments.

One aspect of the project is the development of a 3D soil distribution model exhibiting viscous remanent magnetization (VRM). This is done through field and laboratory measurements of frequency-dependent magnetic susceptibility in soil samples collected at a UXO test grid on Kaho'olawe Island, Hawaii. The model(s) will be a valuable asset to the development of filtering technologies designed to separate strong magnetic geology from hazardous UXO in both magnetic and transient electromagnetic (TEM) data.

Another project that is associated with the research goals of the Gravity & Magnetism Research Consortium (GMRC), involves a current 'hot topic' in the potential fields community – the interpretation of magnetic data in the presence of remanent and self-demagnetization.

A third project is an ongoing study in archaeological geophysics at Chaco Culture National Historical Park, New Mexico. Geophysical data, including magnetic, frequency-domain electromagnetic (FEM), and 2D/3D electrical resistivity (DC), were collected within Chaco Canyon in order to 1) identify

which geophysical methods are appropriate to the local geology to identify subsurface man-made artifacts (such as load-bearing walls of the Anasazi Great Houses), and 2) provide initial (prior) information for future geophysical surveys of interest to the park in their efforts to study past Chacoan Culture.

Proposals

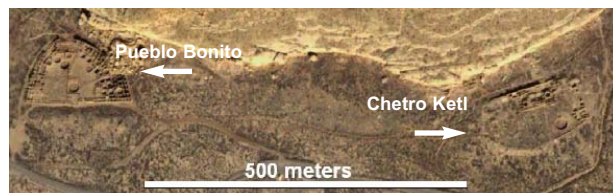
During my several years as a PhD student in the Department, I successfully wrote four CSM technology proposals that resulted in funding to purchase equipment.

We acquired a high-speed potassium magnetometer, a 28-channel SuperSting earth resistivity/IP meter, an EM-63 time-domain electromagnetic sounder for near surface TEM applications, and a Geode 24-channel seismograph. These items have been invaluable tools for teaching, laboratory studies, senior design projects, research, and summer field activities.

I am principal and co-principal investigator in several proposals to SERDP and NSF, related to UXO detection and discrimination, and time-lapse geophysical monitoring of an aquifer storage and recovery (ASR) system, respectively.

Teaching

As a postdoc, I have taken part in teaching four courses, to date. During 2005-06, I was co-instructor with Professor Yaoguo Li in a newly developed senior- and graduate-level course on



Top: Aerial view of Chaco Canyon with Pueblo Bonito to the left and Chetro Kettle to the right. The region between is of large interest to local archaeologists. Bottom: Rich at work setting up equipment to collect FEM data alongside Pueblo Bonito.

application of geophysics for the detection and discrimination of UXO.

That same year, graduate student Whitney Goodrich, and I led a group of budding young geophysics students around Kilauea volcano. Their senior-design research involved using magnetic, electrical, and electromagnetic methods to identify and map hidden subsurface fractures around a large collapse pit within Kilauea caldera, and to identify the underground flow routes of hidden lava-tubes along the lower flow-field of the volcano.

I am instructor for the geophysics module of the field methods course in the Department of Geology and Geological Engineering, and I will teach the GP department's gravity and magnetism junior-level course in the Fall 2007 semester.

...and oh yes, as a postdoc, I now have a window to look out of while I work!

Seeking Explanations The Scaling Problem

The ‘scaling’ issue has intrigued geoscientists for years. Working at Reliance Industries Ltd. on the seismic data processing team, *subsurface imaging* was the buzzword for me. I first realized the importance of the scaling issue in 2003 when I was looking at a log record of a deepwater well drilled off the East Coast of India.

One fine morning my then supervisor asked me to match my processed seismic result with the log I was looking at. To my amazement, most of the strong seismic reflectors did not show up on the logs. The sonic values were running in the same log track! I was shocked, and that first changed my technical mind-set.

I tried to figure out the explanation for such this phenomena, but with very little success. However, one thing was quite clear – I really didn’t understand the wave propagation phenomenon in anisotropic media.

I talked to my supervisor and moved to the reservoir group where well-log and seismic marriages were done. Soon I could see the seismic similarities to the wells in terms of rock-properties (with lots of assumptions) and I worked on seismic-well marriages until 2005.

I was learning fast and soon flying high in the company’s technical skies, and for the first time after eight

years of intensive work, my prediction was going to be tested by coring one of the development wells.

The pilot well was drilled and proved to be as my team expected. My team-members and I were in high-spirits. However, within the next few days the core from two wells shocked me to the extent that I began to consider the necessity for further studies. The core showed different lithology underneath the visible core surface (sands underneath shale layer and vice-versa) at many coring intervals! I did not have a strategy for developing a subsurface model that would give a seismic response favorable to an explorer. The message from Mother Nature again was clear – I needed to learn more.

Eventually I traveled to Cairo and Kuala Lumpur to investigate the problem with experts in industry, but I felt increasingly helpless as the reservoirs we discovered were now more complex and harder to develop.

As a remedy I was already thinking about pursuing higher studies and discussed this with Dr. William Leslie, one of my colleagues and an alumnus of CSM. He told me about CSM and its reputation in similar studies, and in particular about RCP and its research in multi-disciplinary integration techniques in applied geophysics.

Coincidentally I happened to meet Dr.



Prajnajyoti Mazumdar

Praj earned a BSc in physics from the University of Calcutta and a MSc. Tech. in applied geophysics from the Indian School of Mines, Dhanbad. He has eight years of industry experience in petroleum exploration and production. Working for Reliance Industries Ltd., Mumbai, India, he was a part of the team that explored and worked on the development of the world’s largest gas field discovery (2001) in deepwater, East Coast of India. His research topic in RCP is advanced reservoir characterization using 3D multicomponent VSP data.

Tom Davis during his visit to India in early 2006 and discussed the research I intended to do. In due course, I joined one of the globe’s most unique geophysics programs that focuses on reservoir-scale research – the **Reservoir Characterization Project**. Here I will further investigate my capabilities in solving the intricate geoscientific problems in the petroleum industry.



The Cairo Museum.

The scaling problem in Egypt.



A cultural night on the Nile.



The Praj Mazumdar family: wife Udita and daughter Tanushree.

Learning the Industry

Counting Opportunities & Making Opportunities Count

– Kurang Mehta

The years spent in a graduate program are a time of intensive study of a student's subject. It is also a time to explore career options. Both are crucial to the student's future success. What better way to add to your body of knowledge while at the same time exploring possible career opportunities than through an internship.

With that in mind, I felt fortunate to have the opportunity to fill consecutive internships in 2006 with two leading oil companies: Shell and Apache.

These back-to-back internships, both in Houston, gave me the opportunity not only to explore employment opportunities, but also to compare the work environment within a large oil company (Shell) versus that of a relatively smaller company (Apache).

The internship work at Shell was part of my thesis research project on improving the virtual source method by wavefield separation. Working with scientists such as Rodney Calvert, Andrey Bakulin and Jonathan Sheiman made each day productive, both in terms of the science and in getting to know more about each other.

I was surprised to see my increased efficiency while working with the top class scientists at Shell. Because this project was a part of my thesis, my advisor Roel Snieder visited Houston at

the beginning of my internship and again at the end. His presence at Shell, even for one day, led to valuable discussions and brainstorming, hence getting me excited for

more research. The research work I did while at Shell produced two publication-quality manuscripts and a possible patent.

Apart from research, this internship also provided me the opportunity to mingle with other

peer interns. And in addition, during a dinner organized by Shell, we research interns were able to meet the top-level staff of Shell International Exploration & Production, Inc. When I look back on this experience, it is hard to believe that I was exposed to so much in so little time.

The internship at Apache started the very next week following my internship at Shell and was still another new experience. The project at Apache was not a part of my thesis research and, hence, was a completely new topic for me: detection of discontinuous seismic features using variational norm.

On my first day at Apache, I could feel the difference between a big company (Shell) and a smaller one (Apache). I found that one of the biggest advantages of working with a smaller company is the personal attention and the early recognition I received

Even though I was completely new to the project topic assigned to me, I was able to successfully accomplish the project goals. I must admit that this would not

have been possible without the support from my supervisors, August Lau and Chuan Yin, other colleagues at Apache. The internship at Apache, gave me the opportunity to expand my research experience.

Though the types of events organized by Apache were on a smaller scale than those at Shell, they succeeded in bringing me closer to the Apache employees.

These two back-to-back internships have broadened my horizons both in terms of technology and personal development. They not only gave me an opportunity to work with great scientists in the industry but also offered me a flavor of the work environment in a large oil company as opposed to a smaller one.

With increasing available internships at various oil companies, I recommend industry experience to every student.



PhD student Kurang Mehta tests the benefits of a company office.

Kidane Araya

In Houston, a father to hundreds

The following excerpts are from an article appearing in the *Christian Science Monitor*, September 9, 2006, about the efforts of CSM alumnus Kidane Araya (PhD, geophysics, [1993]) to mentor Ethiopians who have fled their country. Kidane works as a geophysicist in Houston, where he lives with his two sons Aaron and Mussie.

When he's not toiling as a research scientist at an oil exploration firm, Kidane Araya is driving his battered Toyota through Texas, bringing comfort, advice, and friendship to detainees awaiting asylum hearings. More than 5,000 Ethiopians and Eritreans live in the Houston area. Araya stays in constant touch with pastors, lawyers, and members of the community who work on their behalf.



Kidane Araya with son Aaron.

Ethiopian émigré Kebede Gebray, resettlement services director for the YMCA's International Services in Houston, says Araya stands out for his humanitarian work. Several years ago, Mr. Gebray asked Araya whether he would be willing to help lawyers translate documents. "From that day on, he just got more and more involved," says Gebray. "He took it as his personal responsibility to help."

Serving the oppressed has been a lifelong priority, says Araya. He graduated with a bachelor's degree in physics from Ethiopia's Addis Ababa University in 1978 during

the "Red Terror," when the government systematically removed perceived opponents by intimidation, imprisonment, and execution. In the mid-1970s, he helped Eritreans escape persecution in Ethiopia by escorting them to villages that would shelter them. "Even now, I'm trying to help those who flee," he says.

Some of those he helps arrive in Houston as stowaways, climbing the anchors of Houston-bound ships docked in the Eritrean ports of Massawa or Assab. Others arrive by plane or car with bogus passports. Still others enter the country on foot, working their way up through Latin America.

Visiting detainees became a priority for Araya after several told him what a difference it made. Now he visits once or twice a week and encourages other Eritreans and Ethiopians in Houston to do so as well. In addition, Araya helps attorneys translate depositions. He assists detainees in locating relatives and gathering documents from home to support their asylum cases.

After asylum is granted, Araya helps former detainees obtain work permits, jobs, and learn "American ways," inviting them into his home when necessary.

Araya came to the US in 1983 on a World Bank and United Nations fellowship. In 1986, he earned his master's in geophysics from the Colorado School of Mines in Golden, Colo., following up with a PhD



GP alumnus Kidane Araya
— photo *Christian Science Monitor*

in 1993. Given the turmoil at home in 1993, Araya decided to stay in America.

Influenced by middle school teachers who were Peace Corps volunteers and an illustrated language textbook filled with anecdotes about American life, Araya had dreamed of living in the US since childhood. He was profoundly moved by the beauty of this country, having crossed the Golden Gate Bridge, visited the Empire State Building, and seen the Grand Canyon.

Sons Aaron, 22, and Mussie, 25, joined Araya in Houston 10 years ago. Inspired by his dad's example, Aaron, a mathematics major at the University of Houston, now works with asylum seekers himself. "I feel extremely proud of my dad, doing what he does, coming where we came from," Aaron says. "It makes you want to do the same."

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A PERSONAL STORY OF STRUGGLE & RECOVERY

from **MARK WINTER**

CSM ALUMNUS & NEW ORLEANS RESIDENT

Alumnus Mark Winter, currently a geophysical advisor with Dominion Exploration and Production, received his BSc (1981) and MS (1985) in geophysics, studying with Tom Davis. In Fall 2006, Mark notified Tom that he had suffered a severe stroke – but promised that he would see Tom at the SEG meeting in New Orleans. Just weeks following the stroke, Mark kept that promise. Mark's physical progress, parallels the struggle and recovery – and the spirit – of his home, New Orleans, as he describes here.

I am recovering from a stroke I had in August, 2006, and my city is recovering from Hurricane Katrina.

I am essentially relearning how to see. From the stroke, I have residual problems with depth perception. Seismic interpretation is visually intensive. My internal image catalog is intact, but seeing patterns and matching that catalog is much more work now. My employer Dominion has been patient, and now I am interpreting, organizing and making presentations pretty comfortably. Much of this progress is thanks to my wife Carla, a vocational rehabilitation counselor.

As a member of the New Orleans Symphony Chorus I am also slowly regaining my singing skills. While singing, it is necessary to read music and lyrics, listen to yourself and to the people around you – all while watching the conductor.

Hurricane Katrina has been quite an education as well. Getting through the first couple of weeks after evacuating our home, involved learning how to run electric generators, sump pumps, and chainsaws, as well as performing roof repair. One of the people we first stayed with was on a life-support system, which we had to be keep running. We helped relatives remove fallen trees

off their house. We left our children in Atlanta with Carla's brother so they could continue school.

Dominion set up an office in Houston and provided apartments. Carla and the kids returned to New Orleans in October when schools reopened, while I commuted back and forth between New Orleans and Houston until April, 2007.

Louisianans are remarkably resilient. Many people I know are working, and spending their spare time fixing their house and keeping life running. From week to week it is evident that more businesses and people are returning and operating within the limits of their emotional and financial resources. The city is slowly returning, but its recovery will probably be measured in decades.

I feel that Louisiana's reputation as a party house is a balance to the difficulties the people here have faced for so long. Hurricanes and flooding have been a part of life in Louisiana for a long time, and there were yellow fever outbreaks until the early 1900s. There are few other places in the United States where people have dealt with as much strife.

The failure of the levees is a hotly



discussed problem. Even prior to Katrina, there have been many struggles in New Orleans between business and political forces over how to balance levee integrity. The many businesses that are on and next to the levees are concerned about having access to waterways for transportation. Some of the nicest parks are on the levees.

It is very difficult to look at a thick, wide cement and earth wall that stands 15-30 feet high and worry about its integrity, unless you have an understanding of how much power moving water has and some understanding of engineering. There was a grass-roots push to replace the old levee board with a regional board staffed by professional engineers and scientists, which met with strong political opposition.

I feel, though, that now Louisiana is moving in the right direction. Most of the government, private, and academic interests are talking with each other and working toward a consensus.

Patience and persistence are critical, both for myself and for New Orleans.



Mark recently presented a talk at CSM on the Gulf of Mexico Loop Current and its effect on coastal sedimentation and hurricane intensity, also showing how hurricanes – Ivan, Katrina, and Rita – impacted the oil and gas infrastructure.

"Patience and Persistence are critical."

G

EOPHYSICS ALUMNUS NAMED

MACARTHUR FOUNDATION FELLOW

George Saunders, 1981 CSM graduate in geophysics, was one of 25 people awarded the prestigious John D. and Catherine T. MacArthur Foundation fellowship in 2006. Saunders is a creative writing professor at Syracuse University in Syracuse, N.Y. His fiction has appeared in *The New Yorker*, *Harper's* and *Esquire* magazines. The coveted MacArthur fellowships of \$500,000 are for people "judged to be of outstanding talent and exceptional creativity, with a record of significant accomplishment and with the potential to facilitate subsequent creative work."

At our request, George submitted the following description of his path from CSM student to geophysicist to honored author.



George Saunders

I was pretty much a washout at Mines. Remember the "look to your left, look to your right, one of the three of you is going to flunk out" speech? I was as close to being the flunk-out as one can get without actually doing it. I have a feeling I was supposed to be that person, but somebody had a personal crisis or inherited a lot of money and dropped out of school and went to live in Paris, and thereby took the bullet for me. (Whoever you are – thanks so much!)

I am badly left-brained. I have no natural scientific proclivity. I was at Mines because of my decent SATs, the intervention of a wonderful high-school geology teacher, and my admiration for him, and also because of the writer Ayn Rand, who taught me (via *Atlas Shrugged*) that scientists were gods walking the earth and everyone else, especially artists, were namby-pamby parasites.

Because I didn't want to be a namby-pamby parasite, and wanted to have friends with names like Howard Roark and Ragnar Danneskold, who sat up late at night talking about eternity while designing innovative-looking buildings and wearing turtle-neck sweaters, I came to Golden, with my

dreams of walking among gods, and my shoddy algebra skills.

Soon, to use the technical phrase: I was "head handed to me on a platter" via Chem I."

The beauty of a Mines education is that it does not negotiate. It is, sometimes, brutal. It has two settings, or at least did in my day: a) thumbs-up, or b) thumbs-down.

For me, it was usually the latter. Occasionally a thumb would go kind of horizontal, indicating: "Well, with the curve, maybe, but not if you keep standing around here begging for a few extra points instead of racing back to your dorm and studying all night."

It was a powerful moral lesson for me to be so consistently, dismally, mediocre. I had a raging metabolism and, in those days, no problem getting by on three hours of sleep a night. I had a mad desire to make good (i.e., not flunk out and be sent back to Chicago, and that much-admired geology teacher, tail-between-legs) and would therefore routinely spend (honestly) 18-20 hours a day, either in class or studying.

In other words, my persistent glorious sub-mediocrity could not be attrib-

uted to lack of will or effort on my part. I was trying as hard as I humanly could.

I was just absolutely terrible at science.

On many occasions I skipped big social events, canceled dates, stayed up all night, then had a middle-of-the-night breakthrough that caused me to ascend to an astonishing, dizzying new height of understanding – and still blew the test next day.

I desperately wished I had been born with different mental equipment – that things would come as easily for me as they did for some of my peers (the guy who designed, in 1981, in Fortran, using cards, a 3-D imaging program; the kids who would take no notes and only study an hour before a test, and ace it), but again and again it was shown to me that no matter how hard I wished and worked – I was simply not in this league, and was never going to be.

This was a great gift.

Failure as gift

Why was it a gift? Shouldn't it have been humiliating and disheartening, shouldn't my self-esteem have dropped like a rock? Well, yes and yes

and yes. It *was* humiliating and disheartening. I began to wonder who I was. My self-esteem *did* drop like a rock. I could often be seen wandering around the campus like Charlie Brown, only with 1970s hair, carrying a P-Chem text, occasionally dropping it, kicking it across the quad, picking it up again penitentially.

This failure was a gift, because it taught me several valuable moral lessons

► **It is *not* true that we can make all our dreams come true.**

In life, there is an element of luck, of neurological predisposition, if you will. Given our neurology, and our physicality, and our temporality, there are some things that are impossible. We see that, in all things, “there but for the grace of God” go we. In other words, having walked through the valley of the shadow of You Stink, I became humbled, more patient with other peoples’ failures, having lived those four years (ok, ok, four and a half) with my own.

► **Failure, inability and/or floundering do not equal moral weakness.**

Good people can struggle. Good people can have trouble, drift, be confused, make bad decisions, nearly flunk out of college. I was a good person, trying my best, and things were still not working out. Suddenly I looked up and saw that the world was full of people like me: Decent, hard-working, struggling, failing.

► **A person in trouble can become a person out of trouble.**

Failure, like success, is impermanent. A person is, in a sense, a snapshot. Great changes are possible, radical transformations happen all the time. Nobody is, permanently, anybody.

From geophysicist to writer

Having learned these lessons, I (barely) graduated, then went overseas, worked in the oilfields in Sumatra, and

gradually – very gradually – became a writer. I wrote because I liked it, because it gave me pleasure, because I found it easy, because I found it a beautiful way of seeing the world.

When I finally wound up in the Syracuse University MFA program in creative writing, I was amazed – suddenly I was that student who didn’t take notes, only studied for an hour before the test, and got A’s.

The scientist within

Though I haven’t seen this in the recruiting brochures, when I look back, I realize that Mines was a perfect training-ground for a would-be artist.

What was invaluable about the Mines education was its intensity, its rigor. It was a world where there were no excuses. When you won, you knew you’d won legitimately. Likewise when you lost. It trained the whiner out of me, and now – when I’m on the 75th draft of a story, and it’s still not working, what I do *not* say is: Oh heck, good enough, I tried my best.

Mines taught me that there is no limit to how deeply you can immerse yourself in a body of knowledge, and that it is a joyful and pleasurable thing to do so. It taught me, in other words, that striving for excellence is its own reward. It stripped me down to my essential self, denied me all of my easy, flattering, ideas about myself, then challenged me to reconstruct myself from that place of honesty.

The person that resulted was a better person – less reliant on preconceived notions, wishful thinking, and projection – more open to what actually *was*; not afraid to change models when new data appeared, not so hesitant to admit error, not so addicted to victory, curious to find out how things really were, regardless of how I wanted them to be.

In other words, in its roundabout, ornery way, Mines made a scientist out of me after all.

More About George Saunders

George Saunders is the author of the short story collections “Pastoralia,” “CivilWarLand in Bad Decline” (both New York Times Notable Books), and “In Persuasion Nation.” “CivilWarLand” was a Finalist for the PEN/Hemingway Award.

He is also the author of the novella-length illustrated fable, “The Brief and Frightening Reign of Phil” and the New York Times bestselling children’s book, “The Very Persistent Gappers of Frip,” (illustrated by Lane Smith), which has won major children’s literature prizes in Italy and the Netherlands.

His work has been translated into many languages, and has appeared in the O’Henry and Best American Short Story anthologies, in the “Best Non-Required Reading” series, and in “Best American Travel Writing.” In 2001, Saunders was selected by Entertainment Weekly as one of the top 100 most creative people in entertainment, and by The New Yorker in 2000 as one of the best writers 40 and under. In 2006, he was awarded a Guggenheim Fellowship as well as the MacArthur Fellowship.

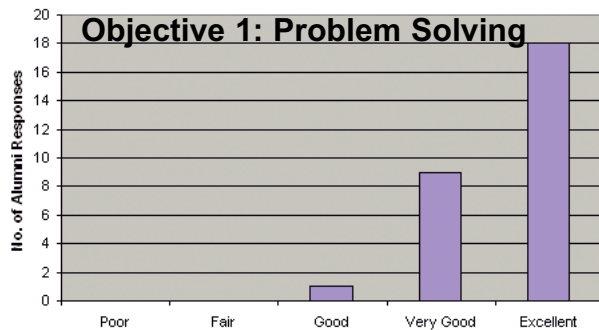


Alumni Responses

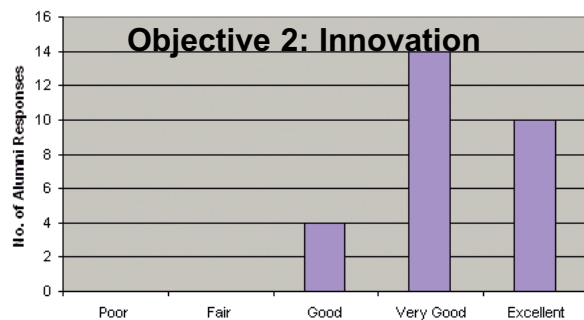
Leadership and Quality Assurance in Applied Science, Computing, Engineering, and Technology Education

What is ABET? The Accreditation Board for Engineering and Technology (ABET) is the single engineering program accrediting agency officially recognized by the US Dept. of Education. ABET only accredits programs, not institutions. There are 8 programs (including Geophysical Engineering) at CSM that are ABET accredited, and each is visited periodically.

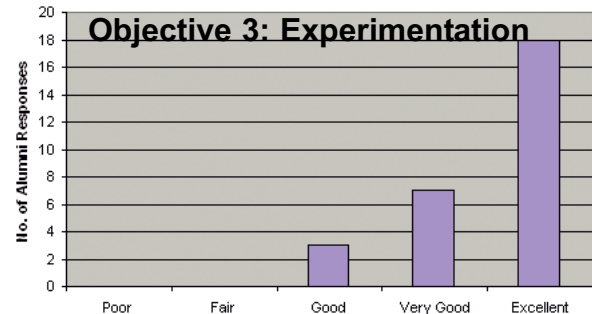
As part of our efforts toward continuous improvement, and in response to guidance stemming from our ABET accreditation review, we sent an email survey to alumni who graduated with a B.S. in Geophysical Engineering during the past five years. In this survey we asked our recent grads to comment on how well we achieved the five objectives of our program in their educational experience at Mines. For each objective they were asked to respond with a rating of poor, fair, good, very good or excellent. We had 28 respondents out of 56 that were solicited. The summary of responses for each objective is given below in a series of bar graphs.



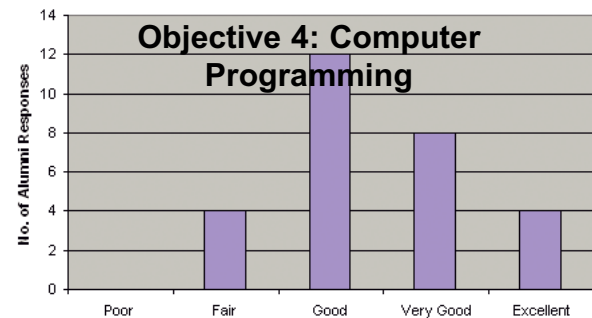
Graduates of CSM's Geophysical Engineering Program will be competent geophysical engineers who think for themselves, and are capable of taking conventional formulations of problems and solving these problems independently using a solid foundation in mathematics, science and engineering.



Graduates will be creative, innovative problem solvers who are able to question conventional formulations of problems, and to conceive and test new hypotheses, new problem descriptions, and new methods for analyzing data



Graduates will be good experimentalists, capable of designing and carrying out a geophysical survey or laboratory experiment, ensuring that the recorded data are of the highest-possible quality, and quantifying uncertainty and incompleteness of data.



Graduates will be competent computer programmers who can write algorithms in a high-level language to acquire, process, model and display scientific data.



Graduates will be imbued with leadership qualities including, but not limited to, the ability to communicate well both orally and in writing, and the ability to make sound decisions in a context with risk and uncertainty.



Alumni Responses

Leadership and Quality Assurance in Applied Science,
Computing, Engineering, and Technology Education

We're Listening! We are grateful for so much thoughtful feedback to our questionnaire. Respondents were invited to offer any comments in response to the survey. We are unable to print all of the responses; however, below we share a representation of them. If you have received the questionnaire, but have not yet responded, we would still love to hear from you.

► Obj 1: Problem Solving

"CSM's geophysics students have a wide variety of electives and the flexibility to design programs in an area of special interest to follow their additional passions, and therefore take on the challenges of real world problems with creativity and knowledge."

"CSM provides a great balance of applied and theoretical geophysics. I think the main thing lacking from my education 'was a business sense' of geophysics. There should be more emphasis on risk, economics, and the importance of geophysics in providing the world's resources ..."

"Overall, I think Mines students are well prepared for the real world and are taught to problem solve, think for themselves, and work collaboratively in teams."

► Obj 2: Innovation

"More opportunity/emphasis on involving undergraduates in research projects with GP faculty would be very valuable. Many of these objectives could be fulfilled through individual research experiences in the projects currently underway at Mines."

"I strongly believe that the CSM geophysics graduates are highly ethical, in the professional sense. Also, they are aware of, or seek to know, the limitations of their solution to a problem."

"...senior design and writing assignments promoted creativity for me to test new ideas."

"Graduates are taught to succeed at

problem solving by emphasizing the importance and consequence of assumptions, model limitations, etc. We are taught to question rather than accept the equation at face value and 'plug and chug'."

► Obj 3: Experimentation

"I suggest that in labs, work with real-world data or client projects to help write professional papers, learn concepts, and have the knowledge that their work has a purpose beyond school."

"Drs. Olhoeft and Larnier were the best professors at quantifying how well we know the data. After my master's, I feel like I'm really getting a sense of how important quantifying error is; I was pretty fuzzy on how exactly to characterize it after undergrad."

"Even though my current PhD studies in earthquake seismology do not necessarily typify the applied nature of CSM geophysics, I have felt very well prepared, and I constantly use the skills I developed as a Mines GP undergrad, many of which my current classmates were never given the chance to gain as undergrads at other, highly respected institutions."

► Obj 4: Computer Programming

"I suggest as a new objective: A graduate will have a solid understanding of industry-standard data collection, processing, analysis, and interpretation hardware and software platforms..."

"I struggled with all the programming assignments and feel that the basics were not covered well enough."

"Provide Java and/or Python introductory and advanced classes."

"Offer a course in MATLAB applications. I find that other universities, especially at graduate level, consider knowing MATLAB a must."

"More work with data processing and modeling would be helpful. In particular, the Oasis Montaj program is a very universal and powerful geophysical data processing and analysis tool."

► Obj 5: Leadership & Communication

"It may be useful to include in the objectives the ability to lead a team and work in a team. The ability to work in and/or lead a team is of fundamental importance."

"I suggest a senior-level course in which all the students direct and teach freshman-level students, gaining additional creativity and leadership experience."

"Include a technical writing course at senior level, perhaps before having to write the field report."

"I believe that CSM students are generally excellent writers and at least above-average speakers. However, I think that courses such as "professional oral communication" should be an undergraduate requirement."

"...thanks for not asking me to derive the wave equation!"

Undergraduate Study Abroad

“We never could have
imagined...”



Lia Martinez



Aaron Girard



Meagan Stephenson

Delft, Holland? Where is that? And why would anyone choose to study abroad there, of all places? These were some of the very valid questions we asked ourselves as we prepared to study abroad our first semester of senior year

We chose to study at Technische Universiteit Delft (TU Delft) because its geophysics program is highly rated and we wanted to experience a student life vastly different from our own here at Mines. What we discovered was an ability to ride our bikes in the wind and rain while holding an umbrella, a love of scarves, stroopwaffles and jenever, 600 year old leaning churches, 50-cent Heinekens at Het Noorden, Sinterklaas, and train travel, to name a few things. We could never have imagined some of the wonderful experiences that we encountered.

TU Delft was a wonder to us in itself, students traveling everywhere on bikes and trains, the age of some campus buildings, and the student housing situations. Once we had done a bit of exploring and ‘meet and greet’ before the semester began, we were able to set ourselves up with all of the classes we needed (one of which was in Dutch) and settle in nicely.

After the first few weeks of being immersed

in the Dutch culture, we got many chances to explore student life, each department bar, and talk to many students – both Dutch and foreign. And even though there was so much to do within Holland, we took every opportunity to explore as much of Europe as possible by train, plane and automobile. A weekend or holiday trip to Germany or France or even Italy was easily possible. We enjoyed exploring and immersing ourselves in every culture and language that we had the chance to see.

When all was said and done, we were sad to leave our new friends from all over the world. Studying abroad opens your eyes to other people and cultures that we, as geophysicists, will no doubt have contact with in the future. It was one of the greatest adventures we’ve had!



Foreign Student Exchange Experience

A Dutch View on Studying

Between Coors Brewery and the Ski Slopes

— Sanne Cottaar

I spent Fall 2006 as an exchange student at the GP Department from Utrecht University, the Netherlands. Not only did I start this school year 5,000 miles from my home country, but it was also my first experience in graduate school. Both experiences were good, and worth all the fuss of going abroad for half a year.

My first thought about Golden, as I was driving down South Golden Road, was “why does a small town like this have so many fast-food places?”.

It also occurred to me that I had just traveled 8,000 miles through the Southwest (enjoying the national parks) without encountering a single street roundabout. And here, all of sudden, are a number of them. Following an American habit, the roundabouts are accompa-

nied by a great number of signs telling people what to do, but I still had the feeling a lot of people don’t really know what they are doing!

I like Golden because it is so small and you can find your way (to the Coors Brewery) pretty easily. However, finding your way around the Green Center, where the GP Department is located, is a different story. I can remember often wondering: “Hmm, if I take these stairs, on what side will I leave the building?”

What I didn’t know be-

cently) shared his lunch with me. But otherwise, I’m glad for all the international foods I enjoyed. I apologize that I didn’t have a lot to offer in return. My new friends never understood how a person can be satisfied with peanut-butter sandwiches for lunch.

The biggest American culture shock for me must have been the time I walked into a party at 9 PM and the party was already totally going. In Europe, parties start later and it is fashionable to arrive late (probably to show that your life is way more interesting than the party).

Studying also means something different in the USA. Upon arrival at CSM, European students receive several warnings that here students are expected to

show up for class. And that you also have to keep up with your assignments instead of starting a few weeks before the exams.

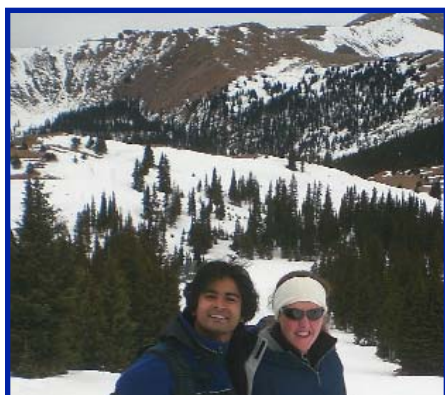
Both of these warnings are definitely valid as the professors at CSM put a lot of time and effort into their courses. In spite of all the studying, I found enough time to get to know my fellow students and the surroundings of Golden. When



Sanne (left) with CSM friends Farnoush and Ritu.



Sanne's international friends.



Sanne skiing at Monarch with Jyoti, “I like snow. We lack it in Holland.”

fore I came to CSM is that the people in the department are here from all over the world. This resulted in many good experiences for me, like crying because the noodles were too spicy – thanks to Yuanzhong Fan, who kindly (inno-

in Holland, I will miss both the people and the mountains in Colorado.

Talking about those fellow students, I’m really impressed by their motivation to study. No matter what the hour, you can always find someone at school working. One night at 2:30 AM, my fellow student Gabi and I decided to prove this by dropping into the Green Center.

Sure enough, we did find somebody – though he happened to be asleep.

I want to thank some people for this special semester. For their classes – Professors Ilya Tsvankin, Misac Nabighian, Gary Olhoeft, Tom Davis and John Stockwell. Thanks to the Center for Wave Phenomena for sharing their research. Thanks to Professor Roel Snieder for his advice (in Dutch). And to all the rest, thanks for the nice times we spent together and for driving me around. Come to Holland and I’ll make up for it!

Geology in Motion

— Alicia Hotovec



For about as long as I can remember, natural disasters have always fascinated me. I grew up on Nova and National Geographic on PBS, and to this day my parents still tape specials for me on the Discovery Channel. Oh yes, I'll admit I grew up in front of the TV, inundated with the media's sensationalized, over-hyped, and oft oversimplified science programming. Regardless, the seed had been planted, and a continuing interest in nature and science kept it growing.

I now consider natural hazards as a kind of 'geology in motion'—spontaneous and ever changing, even within the scope of our own short lives.

Adventures in the USGS-NEIC

The summer after my freshman year at CSM, I started working for the USGS under Dave Wald. Earthquakes are an interest of mine, and luck would have it that the National Earthquake Information Center is conveniently located on campus.

The projects I've been working on are an interesting mix of social science and earthquake seismology.

The first project was Community Internet Intensity Mapping (CIIM, also more widely known as "Did you feel it?"), in which people fill out a questionnaire after an earthquake that assigns a certain intensity value to their location. I used CIIM data to find the coefficients for an equation to describe the attenuation of shaking intensity with distance in the eastern United States. This forced me to learn Perl and gave me a first look at modeling and mathematical regressions. Quite honestly, not a bad start for not having taken any geophysics classes up to that point.

Our current project is the development of a system called Prompt Assessment of Global Earthquakes for Response (PAGER). The system estimates the number of people exposed to different levels of shaking, and will eventually estimate damage and fatality. This will be a great asset to people making decisions on whether or not to send international aid following an earthquake, especially if it is ambiguous if there will be need for it. At the moment, I'm working on calibrating PAGER with historic earthquakes to

approximately 'predict' known damages.

It's rewarding to think that someday my work might help people.

Adventures at USGS-CVO

I've been employed with the government for nearly three years now, and it has opened up a lot of opportunities for me. Earlier this year, I received an email about the USGS Mentoring Program, in which a student or new employee would be paired with someone else in the survey for a year. I had the amazing luck to be paired with John Pallister, head of the Volcano Disaster Assistance Program at the Cascades Volcano Observatory. As part of the mentoring program, I flew to the state of Washington to shadow John for two days and meet the staff at CVO. I met a lot of really great people there and had an amazing time.

I was extremely surprised at how well my geophysics education at Mines prepared me for my visit, Continuum Mechanics and Digital Signal Analysis in particular. I was able to sit in on talks and meetings and understand a great deal of what was going on, whether it was talking about building physical or computer models, or analyzing seismographs in the frequency domain.

I've been invited to spend a month this summer volunteering at CVO. I hope to help various scientists with fieldwork and possibly execute some of my own research for a master's thesis.



MSH from air. While I was in Washington, John took me up in his plane. We flew around Mt. St. Helens and took some photographs. I took this one on our arrival.

COOL SUMMER JOB

– Dylan Mikesell

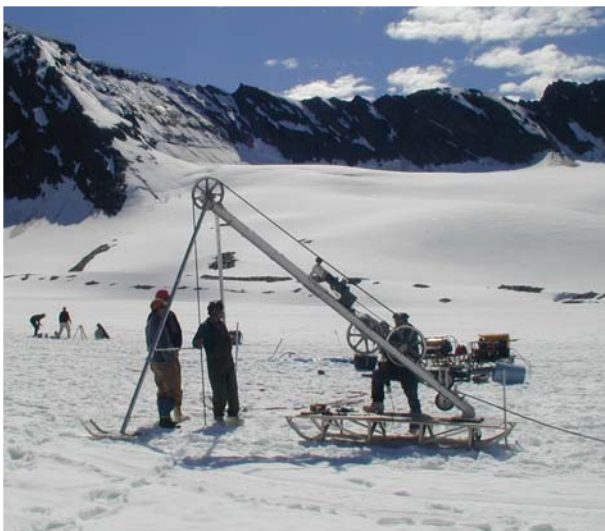


Last summer I had the amazing opportunity to work on an Alpine Glacier research project through the Center for Geophysical Investigation of the Shallow Subsurface (CGISS) at Boise State University. I was employed as research assistant and spent the month of June missing World Cup soccer games and sleeping on a glacier. The glacier we were working on is known as the Bench Glacier, located a short helicopter ride southeast of Valdez, Alaska.

These pictures show Josh Nichols, a BSU graduate student, and myself at our GPS base station placed on a high ridge on the western edge of the glacial valley. We spent



Dylan Mikesell and Josh Nichols at the GPS base station on Bench Glacier, Valdez, Alaska.



three weeks living on the glacier, lugging around GPR equipment. The project involved trying to image the internal structure of the glacier to locate fractures and conduits through which surface meltwater travels to the bed of the glacier. As of recently, this phenomenon has become of increasing interest to glaciologists because of the impact that surface melt has on glacier flow rate.

The project involves faculty and students from the University of Montana and University of Wyoming. The third picture shows a University of Montana student and myself standing next to the drilling system used to reach the glacier bed where water pressure is measured.

Dylan Mikesell graduated from CSM in December 2006 CSM with a BS in geophysics. He currently works for Olson Engineering, Inc., Wheatridge, Colorado. He plans to begin graduate studies at Boise State University. In addition, Dylan is a fly fishing guide and instructor.

'Conflict of Interests' Opens Double Life for GP Undergrad

– Dan Liechty



President of YogaDog Studios, screen writer, assistant director, and actor, Dan Liechty (center) on the Denver set of "Flat Dog Dreams."

After a long day of theoretical electromagnetic fields and a seemingly healthy dose of continuum mechanics, assuming any amount of exposure to be health beneficial, I like to unwind with a short run. Perhaps a track workout or maybe even a few more hours of inverting magnetic data. But when the sun goes down and the city lights of Denver begin to rise, so do the mics, lights, and cameras of the independent film 'Flat Dog Dreams' a YogaDog Studios Production.

The Synopsis

A short comedy based out of Denver. A rogue graffiti artist played by Dan Liechty (myself) hitches a ride into Denver looking for a new canvas. He finds his billboard on the roof of a popular diner, also home to a vandalizing gang of upper class white suburbians, The Juice, led by Deefer (Ian Storz). But perhaps more pressing than territorial scrapes, yes that's right—scrapes, this one's action packed—Sean must escape the constant pursuit of his long-time nemesis with a vengeance, Dalton, a bounty hunter from Amarillo. Has Sean taken on too much? Can he defend real art from the gangs of Denver? Can he avoid capture and confinement? And can he keep his distance from the family he has found in the diner itself? I certainly hope so, but we all know that's not likely.

This comedy will take you through the darkest alleys of Denver and lead you through the lives of the wealthy, the desperate, the lonely, and the lost.

Fork in the Road

I began writing the "Flat Dog Dreams" script last June shortly after meeting Director Michael Starks, who is a physics major and part time calculus teacher at Red Rocks Community College. After three months of preproduction and script work, mostly done in the off hours of my time at Ur Energy (uranium exploration company) in Littleton, filming finally began, lasting from September through December of 2006. After four months of editing, the premier was released and "Flat Dog Dreams" was distributed to several film festivals throughout the country and the world.

Film has always been a passion of mine. After making films for the past five years, and heading Mines Athletic Films for the Mines Athletic Department, I knew I wanted to take the next step. It was between film school and Mines when deciding on my post high school plans three years ago, but geophysical engineering won out. It wasn't until recently that I built up the nerve to attempt writing, producing, acting and heading the film production company YogaDog Studios on top of CSM's rigorous academic demands.

When speaking to other geophysics majors and professors, the first reaction is, "You do *what* in your spare time?" But more interesting is the reaction of directors, cinematographers, gaffers, grips, and actors when they say "What the heck is a geophysicist?"

It's a clash of two worlds, but it's the only way I know how to keep my sanity. So if you're looking to break into the world of cinema or if you're just an independent film buff, feel free to contact me. The next two installments of Flat Dog Dreams are currently underway and slated for filming the summer of 2007. Check out our site at www.FlatDogDreamsMovie.com for more details and to view the trailer.



Tools for Life

Athletics & Academics: A Good Team

Mines is one of the most well known schools for geophysics and engineering, but did you know that Mines is also one of the top NCAA Division II athletic schools? After the Air Force Academy, CSM offers the most varsity sports in Colorado. Over 75 Mines athletes have received All-American honors and hundreds have received All-RMAC accolades.

In the 2005-'06 academic school year, a record 400 athletes competed for CSM; 24 were All-American and 58 were All-RMAC. That year the CSM athletic program finished 2nd in the RMAC/Wells Fargo Cup and 24th in the U.S. Sports Academy Director's Cup for overall athletic performance. In addition to varsity teams, Mines offers a large variety of intramural and sports club activities.

Athletics and classroom environments are complements of each other, meant to develop the qualities and tools needed to become the complete engineer and person. The classroom environment teaches one part of the equation, such as math, physics and some team work. Athletics is needed to teach the other part of the equation, such as integrity, discipline, and sacrifice.

I have been fortunate to participate as a varsity athlete here at CSM. As an undergraduate, I played varsity soccer and ran varsity track. Each of those four years, the soccer team was nationally ranked in the top 20 with three RMAC championships. The track program was equally successful, placing in the top 25 nationally every year. As a graduate student, I'm competing for the Boulder Running Company and training for the 2008 Olympic Trials in the 800 meters.

Over my time at CSM, I have had my share of injuries and failures. From those I've learned how to work hard, to have humility and integrity, and most importantly – I've learned that success is not measured by trophies and awards, but instead by knowing that you used your potential to the fullest.

Competing in athletics while going through the geophysics curriculum at Mines is not easy – but you do learn time management. One semester my schedule was to go to soccer practice in the morning, school for 6-7 hours, then soccer practice in the afternoon followed by track practice. Then there was homework to do. Ironically, that was my best semester, grade-wise.

Other geophysics students have done the same: Justin Modroo, a nationally ranked freestyle skier, Monica Guerra,

– Jared Peacock, MSc student



Winning 6th place for the Distance Medley Relay at the 2005 NCAA Division II National Indoor Championships in Boston, MA, are CSM students (left-right) Jared Peacock (geophysics, 800m), Larry McDaris (petroleum, 1200m), Ross Wagle (geophysics, 400m) and Joel Hamilton (economics, 1600m).

a CSM swimmer, Ross Wagle, an All-American in the Distance Medley Relay in Indoor track and field, Dan Liechty, a soon-to-be All-American in the Steeple Chase, Brian Hart, part of the 2005 RMAC champion soccer team, and many others. Faculty also participate in athletics: Professor Roel Snieder is a fellow half miler, and as faculty advisor to the the CSM swim teams, Professor Dave Hale is often in the pool working out.

Athletics has allowed me to travel and meet people all over the country. Among them was Olympian Matt Hemmingway, the 2004 high jump silver medalist (one of the oldest high jumpers to ever earn a medal).

While competing on the corporate track team during an internship with ExxonMobil, I talked with Bob Beamon, the first to jump over 27 feet and 28 feet, all in the same jump at the 1968 Olympics in Mexico City. He still holds the Olympic record at 29'-2.5". And through soccer I've met U.S. legends Steve Trittschuh and Marcelo Balboa.

All these people have succeeded on the world stage, yet as Matt Hemmingway told me, "This piece of medal doesn't make me better than anyone; I'm just another person who has the ability to jump high. What it has given me is character..." The athletic and academic environments at CSM work as a team to do just that, whether or not you are an All-American or a Best Paper Award winner.

Let it flow, let it flow, let it flow!

Senior Design Project: Kilauea, Hawaii

– Meagan Stephens



The Flow Field Group on Kilauea : Helen Kershaw, Lia Martinez, Tom Blanchard, and Meagan Stephens. Photo was taken by trip advisor and graduate student Whitney Goodrich.

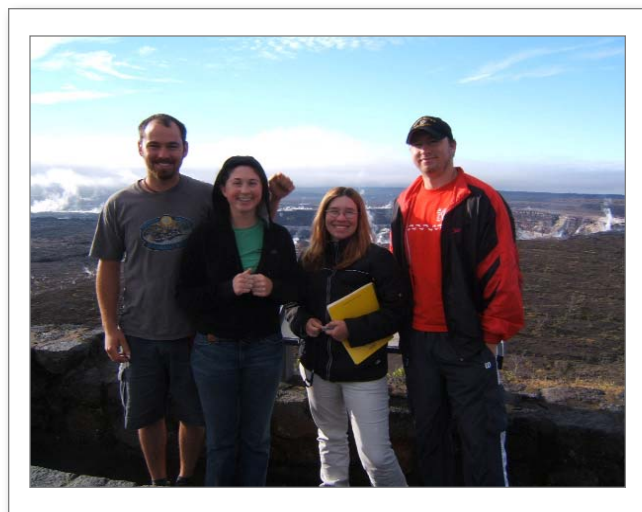
The thought of planning an extra field session for the class of 2007 to Hawaii first became a dream the beginning of our sophomore year at Mines. Students had heard rumor that it was possible to organize a second field camp for any students that wished to attend to a destination of our choice doing a project that interested the class. Our class immediately decided they wanted to study volcanoes and were interested in traveling to one of two places, Hawaii or Italy. As time went on, there was little to no discussion about planning and fundraising for our adventure and the trip fell to side as we all attended to our current classes. The dream resurfaced mid-way through our fall semester junior year and the planning frenzy began. However, due to lack of funds, many students had to drop out of the project. Our trip to Hawaii was then converted to a senior design project that was to take place the following semester!!

There were numerous things to be addressed before this project would be approved by the Geophysics faculty. What would the objectives of the projects be? Which faculty member would represent the group and go along on the trip? Where would we get funding for our chaperone(s)? Which equipment could/would we take? What safety precautions needed to be addressed? Who would be our contact in Hawaii? And the list goes on...

When all was said and done there were eight students and two graduate students that would embark on this adventure. The flow field group, which would complete their project in one semester, consisted of Lia Martinez, Meagan Stephens, and two foreign exchange students from Leeds University,

Helen Kershaw and Tom Blanchard. The caldera group, which would complete their project in two semesters, consisted of Stephanie Cook, Alicia Hotovec, Dustin Lanci, and Jon Parker. After long hours of work and planning the flow field group decided to carry out EM 31, Magnetic, and Very Low Frequency (VLF) surveys over the active flow fields. As spring break approached the instruments were packed and shipped and we all got ready for our trip.

After a long flight over the Pacific Ocean we landed in beautiful Kona, Hawaii. The gang hung out at the terminal while our chaperones fought with the rental car people to get the vehicles we had reserved. After stuffing all our gear into the vehicles we drove around to the other side of the island only to be met by rain. The remainder of the two weeks consisted of a massive amount of rain with each member returning to our little bungalow in the woods soaked. Even though we endured blistered, heavy packs and long hikes across the barren waste lands of the flow fields we still found time to go out and have fun. On our days off we toured around the Big Island of Hawaii finding local beaches to play Frisbee in the water and try out our surfing skills. Although there were many long nights spent organizing our trip and processing our data, the trip was well worth the effort.



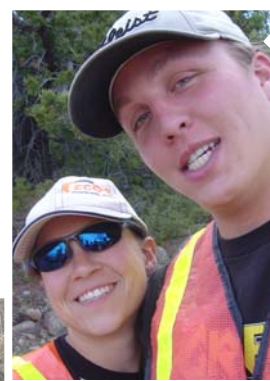
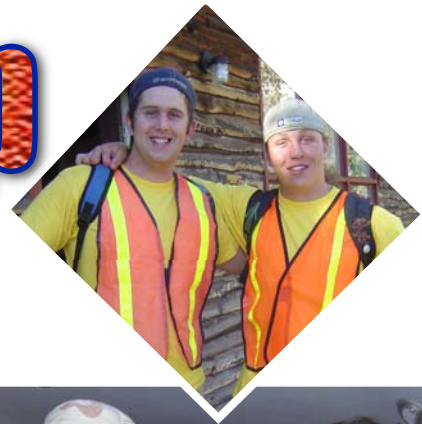
The Caldera Group at the Hawaiian Volcano Observatory: Dustin Lanci, Stephanie Cook, Alicia Hotovec, Jon Parker. Photo taken by trip advisor and postdoctoral fellow, Rich Krahenbuhl.

Field Camp

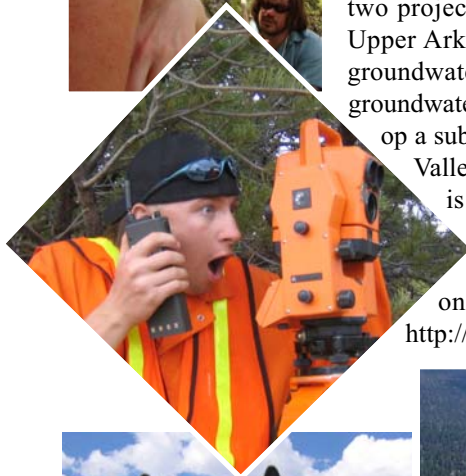
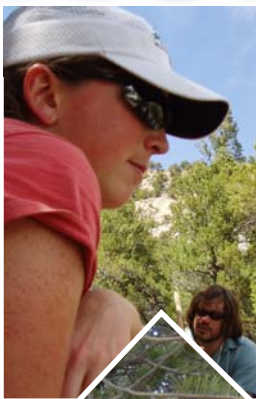
The 2006 Summer Field Camp, an undergrad requirement for graduation, continued our activity of the past several camps in Chaffee County, Colorado, located in the Upper Arkansas Valley, south of Buena Vista and north of Salida. There are not too many places with more spectacular scenery than this setting in God's country at the base of Mount Princeton.

The four-week hands-on field experience involved two projects: 1) to further develop models for the Upper Arkansas River valley that characterize the groundwater flow, where it is apparent the shallow groundwater supply is running low; and 2) to develop a subsurface geology model of the Fish Creek Valley in order to determine whether or not it is feasible to build a proposed dam at that site.

These project reports are accessible online from the department's homepage: <http://www.mines.edu/academic/geophysics/>



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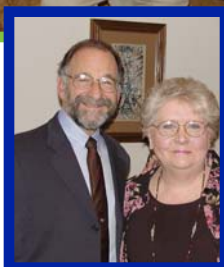
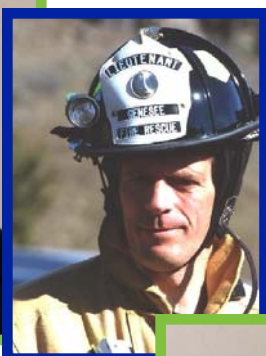
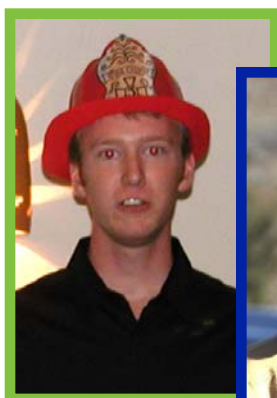
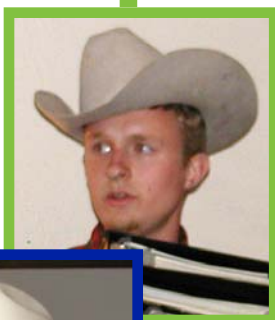
Saluting the Faculty

GP Banquet 2006

The popular tradition of GP Day has the dual purpose of celebrating the arrival of spring (never mind the snow often still on the ground) and the upcoming commencement ceremonies. The day is set aside for a barbeque lunch, volleyball challenges, and other out-of-doors entertainment.

The festivities continue into the evening with a more formal banquet, hosted by the juniors as they salute the graduating seniors and faculty through skits and the presentation of 'meaningful' gifts.

The cast of the Spring 2006 skit might have resulted in mistaken identities...but certainly resulted in an evening of fun. Can you pick the imposters?





C E L E B R A T I O N S

GRADUATES

2006



BS Geophysical Engineering, left to right: Justin Rittgers, Michael Palmieri, Brett Lyons, Jennifer Livermore, Monica Guerra and Trevor Ensele.

Spring Convocation



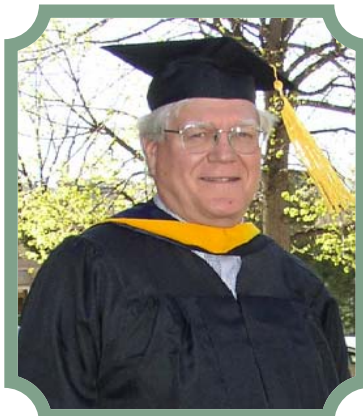
Ross Wagle, BS
Geophysical Engineering



Tanya Slota, BS
Geophysical Engineering



Kristin Schmidt, BS
Geophysical Engineering



David Balogh
Professional Masters
Petroleum Reservoir Systems

Also Receiving Degrees:

BS, Geophysical Engineering

Joshua Linville-Engler
Andrew Stolzmann

MS, Geophysics

Kathleen Baker

PhD, Geophysical Engineering

Charles Oden



Huub Douma
PhD, Geophysics

GRADUATES

2006



PhD Geophysics, left to right: Xiaoxia Xu, Dave Stillman, and Ronny Hofmann.



PhD Individual Interdisciplinary, right: Dave Coulter with Department Head Terry Young.

Winter Convocation



BS Geophysical Engineering, left to right: Dustin Lanci, Stephanie Cook, Brian Stolzmann and Dylan Mikesell (recipient, Geophysics Outstanding Graduating Senior Award).



Don Keighley
MS, Geophysics

Also Receiving Degrees:

MS, Geophysics

Jeong Min Lee
David Sinex

MS, Geophysical Engineering

Shannon Higgins

PhD, Geophysics

Yaping Zhu



Mike Rumon
MS, Geophysics

Thank you, GP Alumni!

It is great to hear from you!

Read all about it!

We are grateful to those alumni who quickly responded to our survey concerning the bachelor of science program objectives for Geophysical Engineering. You will find a compilation of their ratings of the program objectives and a sampling of their comments and ideas inside on pages 18 and 19.

We want to hear from **you!**

Alumni, employers, and other interested readers –

We would love to hear your thoughts on the questions posed to recent alumni (see page 18), as well as on these further questions below. Send us your feedback.

- The value of our undergraduate program being accredited through the Accreditation board of Engineering and Technology (ABET).
- The importance of professional registration as a geophysicist or geophysical engineer.



Ted Royer (BS '01, MS '04) in Taiwan.



Paul Schwering (BS '05) in Alaska.



Dustin Lanci (BS '06) in Alaska.



Elise (BS '29), daughter of Amy Walker (BS '01)

- Other objectives we should aim toward in educating our students.
- How successful is a Mines education in preparing students for future employment.

Thank you!

Hadi Balhareth
Salman Bubshait
Will Burnett
John Chakalis
Jordan Dimick
Fariz Fahmi
Suzanne Heskin
Dave Hollema
Sarah Kelly
Liz LaBarre
Erin Lake
Brett Lyons
Vanessa Mitchell
Justin Modroo
Julia Oakes
Justin Rittgers
Emily Roland
Ted Royer
Michael Rumon
Cambrey Salazar
Paul Schwering
Sarah Shearer
Tanya Slota
Armando Sosa
Angie Southcott
Tashi Tshering
Amy Walker
Mark Wennogle
Jonathan Woolley

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