geophysics

Colorado School of Mines Spring 2008

geophysics

Spring 2008
Colorado School of Mines

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From the Department Head

In this year's newsletter, we present many familiar themes – field camp, study abroad, internships, alumni. We also devote a large section to research activities. The Department of Geophysics is unique at Colorado School of Mines in maintaining a 50-50 balance between its teaching and research activities. The department is responsible for $4-5 million of Mines' approximate total of $30 million in sponsored research. Some of the department's research is done in centers, such as the Center for Wave Phenomena (CWP), the Reservoir Characterization Project (RCP), the Center for Gravity, Electrical and Magnetic Studies (CGEM) and the Fluids in Rocks consortium project (now consolidated with what used to be the Center for Petrophysics – CENPET). Other research is led by professors such as André Revil and Gary Olhoeft whose interests are quite broad and whose funding, therefore, derives from a wide range of diverse sources.

Terry

The Department introduces new staff member **Dawn Umpleby**. Dawn has left the fast-paced life of a securities trader to pursue a new passion – the geosciences. Now she is enjoying daily exposure to the "geo" jargon and activities of the GP Department. Welcome, Dawn!

Department of Geophysics faculty and staff. Back row: Paul Sava, André Revil, Dave Hale, Robert Benson, Rich Krahenbuhl, Ilya Tsvankin, Tom Davis & Yaoguo Li. Front row: Susan Venable, Sara Summers, Terry Young, Michelle Szobody & Barbara McLenon.

Growing Geophysicists of the Future

First in Line:

Attending the Student Leadership Symposium Premier

– Aaron Girard

During the 2007 SEG Annual Meeting, three students in the CSM geophysics department were at the forefront of the first SEG/Chevron Student Leadership Symposium (SLS). Haider Alabdulaal, Jonathan Parker and Aaron Girard joined forces in San Antonio with 38 other students from 16 countries for a week of learning, experience sharing, and international networking.

Aaron Girard (back row, second from right) waves from the Alamo in San Antonio during the SLS Symposium.

Upon arriving in San Antonio, the SLS attendees took part in a day filled with activities. After introductions from the SEG president and SEG Foundation members, we were treated to three student presentations, each about how the individuals are helping to spread knowledge of geophysics.

We first heard about a joint effort by students from Stanford University and the University of Bucharest in which they built a student-run geophysics field session in Romania for the students there. Though it required a huge effort, the event benefited all of the students and universities involved.

The next two presentations, from Novosibirsk State University, Russia, and the University of North Carolina, showed examples of how those students were bringing knowledge about geophysics and higher education to students in public schools near their universities.

From these examples, the SLS attendees realized that similar projects could be implemented in the future by others elsewhere. It is our hope that CSM students will be among the next to give presentations of how we have collaborated to spread knowledge of geophysics.

A highlight of the SLS was a group discussion with SEG Foundation members on how the SEG can better serve student members. In small groups, each person was able to give input for SEG improvement. Actually having a voice in the leadership of a worldwide society gave us insight into what it takes to run an organization so large and influential.

Our social time together included exploring the city of San Antonio, sharing stories of where we came from, and discussing how to combine efforts to benefit the worldwide community.

We quickly found that we have much in common even though we are from so many different places and backgrounds.

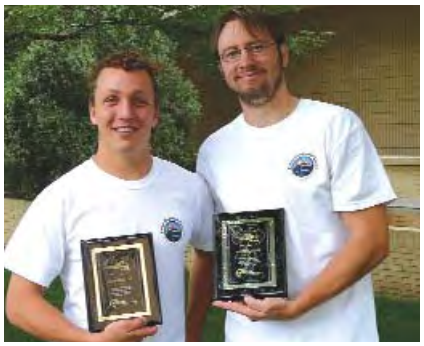
As our educations and careers in geophysics progress, we will continue these worldwide friendships, and hopefully use them for the benefit of the SEG, geophysics, and the worldwide community.

Meeting the (Rocky Mountain) Challenge Head-on

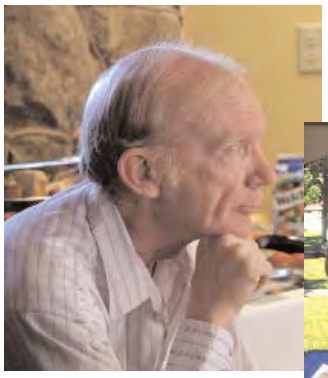
The 2007 Rocky Mountain Regional SEG Challenge Bowl was held on the CSM campus in September, with former SEG president Peter Duncan serving as Master of Ceremonies for the geoscience quiz game.

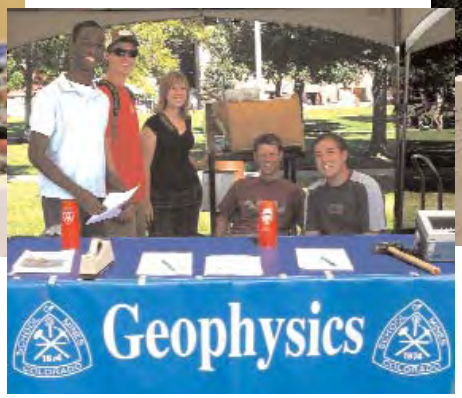
The team of graduate students Jyoti Behura and Rodrigo Fuck came to the finish line neck-and-neck with undergraduates Aaron Girard and Jon Parker. To the great relief of the near PhD's, they won the regional contest and an invitation to compete in the Second Annual SEG Challenge Bowl Finals in San Antonio, where they placed third.

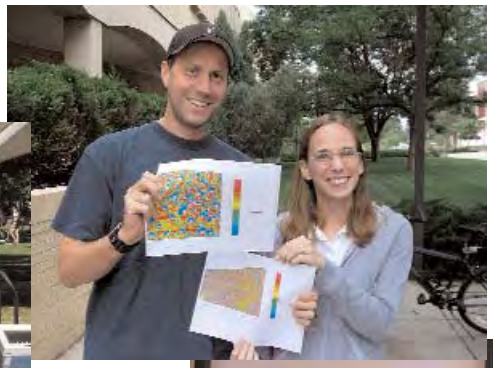
First place team, Jyoti Behura and Rodrigo Fuck, PhD students studying in the Center for Wave Phenomena.



Second place team, Aaron Girard and Jonathan Parker both received their BS degrees in December 2007.







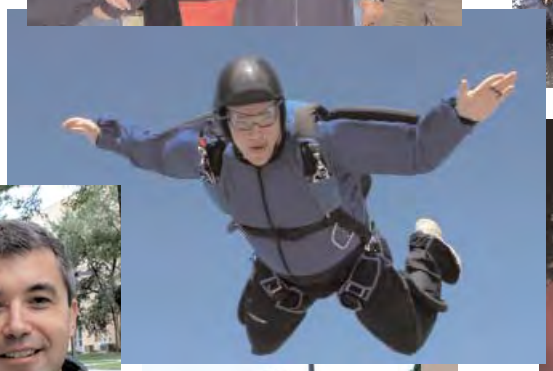
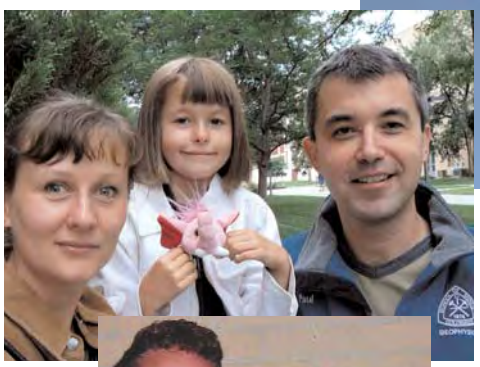
Year in Review






Year in Review

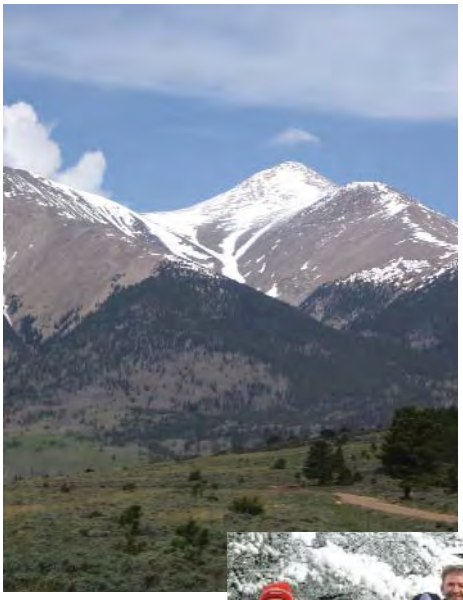


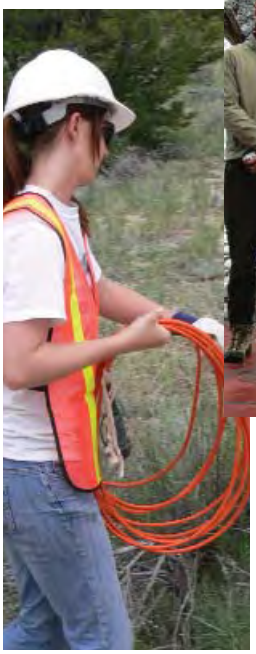


Field Camp 2007

The Upper Arkansas River Valley

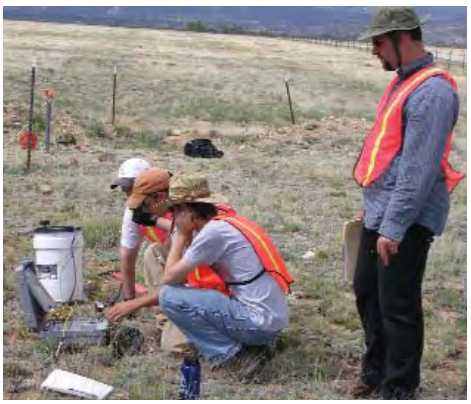


Under the leadership of Mike Batzle, Baker Hughes Professor of Petrophysics and Borehole Geophysics, the Geophysics summer field camp has taken on a partner – Boise State University. Both last summer and this, Boise State professor Kasper van Wijk has brought students from his program to join the camp. It is not unusual for students from other universities to participate in the Mines summer field camp. In recent years students have come from universities in such diverse places as Missouri, Venezuela and India to participate. What is different about this new arrangement is that BSU students pay tuition and earn credit at their home university, they bring some of their own instruments, and Professor van Wijk joins with Mines faculty members in teaching the students. The arrangement is a natural in that Kasper earned his PhD at Mines and his wife, Mila Adam, is currently enrolled in our PhD program.



2007 CSM/BSU field camp group.

The CSM/BSU connection as represented by BSU Prof. Kasper van Wijk and his wife Mila Adam, CSM PhD student, shown above with their daughter Sasha.



Society of Women Engineers (SWE)

– Rebecca Johnson

The CSM section of the Society of Women Engineers (SWE) is among the largest in the nation, with over 340 members. SWE is a non-profit educational service organization of student engineers, as well as professional women and men in engineering

I joined the SWE bandwagon my freshman year, especially because of the fabulous lunches provided every Wednesday. During the next summer, I was recruited to plan an evening of entertainment for the SWE Region i Conference hosted at CSM in March 2007. Because it was summer, and I was experiencing the boredom associated with not having homework, I agreed.

The Region i Conference kicked off with the Friday-evening events I was in charge of planning. Women from schools in multiple states joined us for a barbecue, line dancing lessons, and comedians. I enjoyed arranging every detail down to the cookie-filled cowboy hats as table centerpieces.

Following that success, it was suggested that I run for the 2007-2008 vice-president position and apply for the SWE Florence Caldwell scholarship.

When I learned that the office involved planning two annual events, I was hooked. That spring I not only received the Florence Caldwell scholarship, but was also elected to the position of vice-president.

Rebecca and GP classmate and fellow officer, Cericia Martinez (SWE secretary).

I spent the first few weeks of fall feverishly planning SWE's annual Evening With Industry, a dinner and networking night prior to the Fall career fair. With over 50 companies in attendance, it was the largest such event in SWE's history. Nearly everything went flawlessly, including the brilliant keynote speaker, Marsha French of ExxonMobil. I also organized the SWE annual Networking Reception for the Spring 2008 career fair.

SWE is a fantastic outlet for networking, volunteering, and fun. If that isn't enough reason to join, there's always lunch on Wednesdays!

Engineering Women

Women in Geophysics (WIG)

A group of WIGs on the trail: (left to right) Nadine Young, Cericia Martinez, Merrick Johnston, Alicia Hotovec, Elise Goggin, Karoline Volker, Aubry Bingham and Arianne Dean. Currently, women comprise 30% of geophysics undergraduates at CSM and 40% of graduate students.

What CSM geophysics women may lack in numbers, they make up for in brains. They are women who know how to balance hard work and good play.

Women in Geophysics (WIG) is a mentoring program open to all women geophysics students and interested Denver metro-area female geoscience professionals. The goal of WIG is to promote the academic success of female students as they prepare for their careers.

This school year the WIG group, led by students Karoline Volker and Merrick Johnston, took part in a variety of informational and social events. Among those was a breakfast seminar presented by Eve Sprunt of Chevron, "After the Honeymoon." As a woman who has had a successful career in the petroleum industry, Dr. Sprunt is a strong role model for others.

On a more adventurous outing, the WIG group took advantage of perfect Colorado weather and fresh snowfall for a day of snowshoeing, hosted by Department Head Terry Young and his wife Nadine, on scenic Genesee Mountain.

The many benefits of the WIG program are shared by students and mentors alike. If you are a professional living in the Denver area, please consider meeting our group of women students.

Thank you

Congratulations to Hess Fellowship recipients Xiaoxiang Wang and Paritosh Singh.

IN THE LAST COUPLE YEARS Hess Corporation has distinguished itself by its gift of a graduate fellowship to the Department of Geophysics. During a decade when the number of resource companies and geophysical service companies has dwindled because of mergers and acquisitions, and the surviving entities have reduced their costs by reducing the number and size of their fellowships, Hess Corporation has instituted a fellowship at $30,000 per year that beats all the competition!

CSM maintains the excellence of its graduate program by offering financial support that helps attract the brightest and best students. We are able to do so only because of the generosity of a company like Hess that comes along to provide the financial resources for competitive graduate fellowships.

Thanks, Hess!

The Department is grateful to Shell Oil Company for its financial support of this newsletter—and much, much, more! Shell's financial support also contributes to a graduate fellowship, our annual faculty retreat, CSM's booth in the exhibition hall of the SEG annual meeting, and our outreach efforts to K-12 students and their teachers in relation to our field camp activities.

Shell's financial gift also sponsors activities of our undergraduate (SSG) and graduate (SGGS) student societies. Many articles in this newsletter feature these activities for which we receive sponsorship from Shell.

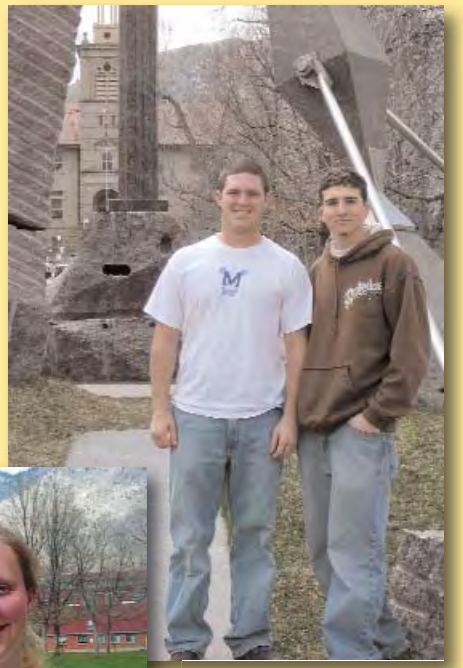
Thanks, Shell!

Payne Scholars

Jim Payne

Thanks to a generous endowment from alumnus Jim Payne and his wife Arlene, the GP Department has been able to award undergraduate scholarships and a graduate fellowship to three students. Undergraudates Matthew Nobles and Orion Sandoval, both from Pagosa Springs, are recipients of scholarships named in honor of former geophysics professor George Meredith.

Graduate student Shannon Simons has received a fellowship honoring former geophysics department head John Hollister. This fellowship will sponsor her studies toward the Professional Masters degree in Petroleum Reservoir Systems.



Congratuations to Shannon Simons (left), Matthew Nobles (upper-left) and Orion Sandoval.

Special thanks to Richard Degner who has personally established a generous endowment through the SEG Foundation to help support CSM's geophysics field camp.

CSM Connection @ Global Geophysical

CSM Alumni at Global Geophysical: Left to right standing: Ed Newberry, Director of Information Technology; Duncan Riley, VP of US and Canada operations; Clark Capes, Operations Supervisor for Algeria. Left to right seated: Tom Fleure, SVP of Geophysical Technology; Richard Degner, President & CEO

GLOBAL GEOPHYSICAL SERVICES, INC. is a worldwide land and shallow marine seismic acquisition solutions company that was formed in 2003. With impeccable timing, the company launched its first land seismic crew in mid-2005. With the recent explosion in oil and gas prices and related exploration, Global has deployed 14 crews worldwide and has plans to launch eight additional crews by year end 2009. The company currently has onshore seismic operations in Algeria, Argentina, Kurdistan, Oman, Peru and the US, as well as shallow marine/ocean bottom cable operations in the US Gulf of Mexico and in the Gulf of Khambat India.

Colorado School of Mines is well-represented in the senior management team of Global. Richard Degner, founder, President, and CEO of Global, graduated in 1983 with degrees in both Geological and Geophysical Engineering. Tom Fleure, Senior Vice President of Geophysical Technology, earned his Geophysical Engineering degree in 1982, while Duncan Riley, another cofounder and Vice President over US and Canada operations, graduated with a degree in Geophysical Engineering with minors in Geology and Computer Science. Other Miners at Global include Ed NewBerry, Director of Global's IT, and north African operations manager Clark Capes, currently assigned to Global's Hassi Messaoud office in Algeria.

Degner and all of these Miners gained their extensive experience working for the world's leading geophysical contractors for over two decades before joining together to launch Global. One of the company's most successful strategies for attracting the best, most experienced seismic professionals was offering ownership to all employees and instilling a culture that fostered an entrepreneurial spirit, absent of corporate politics and bureaucracy. It seems to be working—now with over 500 employees who are highly motivated by the opportunity to create value in a company in which they have vested interest! Global has a growing referral list of greatly satisfied clients.

– Carla J. Hundl
Corporate Communications Manager
Global Geophysical Services, Inc.

A World of Possibilities Internships

Preparation for a career in geophysics is often best achieved through hands-on experience; thus, the requirement of field camp in our curriculum. But another great learning tool is that of internships. We are grateful to the companies that provide such opportunities to our students. Here we print short excerpts from only a few reports – our apologies to the student authors.

Anadarko Petroleum
My Trip Offshore

– Shannon Simons

On the deck of *The Millennium.*

I had the wonderful opportunity to intern for Anadarko Petroleum Corporation this past summer. We went on field trips almost every week to break up the monotony of working at a desk. The most memorable field trip was offshore in the Gulf of Mexico to a deep water drillship called *The Millennium*.

Anadarko chartered a plane to Houma, Louisianna, where we picked up our helicopter. This was my first helicopter ride, and we actually flew *through* a rainbow that went all the way around us!

When we landed on *The Millennium,* it was an exciting time because they had just finished drilling through the salt earlier that morning. We began our tour of the ship in the bridge where I was amazed by the size of the steering wheel: six inches in diameter to steer the 700-foot ship! Another thing that amazed me is that they can keep the ship steady in the strong currents in the deep water: They are able to center over the well to within one meter! During the tour we saw most of the ship. We learned about mud and the system that pumps mud down-hole and back up. We were able to go into the logging trailer that collects the log data, where we almost wiped out all of the data they had collected at that location by keeping the door open too long! We were able to go to the moon room and see the large hole in the middle of the ship, and we ended our tour in the dog house. We were also able to go on the drill floor briefly to watch a connection being made.

Overall, this was an unforgettable experience. I will definitely take every chance I get to go offshore.

Global Geophysical
Subtle Extremes

– Jesse Havens

Along the path to maturity, sediment will go through chemical and physical weathering, fluvial sorting, and rigorous transport until a well rounded, well sorted and highly resistive material is spewed out. A parallel path occurs en route to becoming a geophysicist. The apex of this formation into a competent and capable engineer, the deep channel with turbulent flow working to break down all those angular surfaces, happens outside of school.

Clinton, Arkansas wields an unruly 2,283 residents—don't be fooled by the small town look, it's the bold name on the map. I was there on behalf of Global Geophysical to gather seismic data deep within the thickets of the countryside. The first day on the job I was a lineman, a juggy, a cable slinger; whatever you want to call them. Hard work, yet after a long day of heat and exhaustion, the team I worked with had energy to race each other to the van.

The purpose of my trip was to learn the inner workings of a seismic crew; I did that. I also learned that the dynamic field of geophysics is a gateway to experiences not yet experienced, a way of seeing the unseen. A culture so diverse, I am assured I won't run out of places to look.

Internships A World of Possibilities

Petroleum-Geo Services
Revelations of Real Data

– Gary Scherer

My summer internship experience in the data processing department of PGS in Houston was nothing short of extraordinary. In the first week, I was given a real project with the purpose of creating a company-wide standard methodology for azimuthally-dependent onshore seismic data processing. This methodology was being developed, with collaboration, in order to provide a new service to the client.

Given a real data set (not synthetic), I was asked to review the processing that had already been completed, analyze the fold of the data from differing azimuthal orientations, conduct an extensive velocity analysis of the data from these differing azimuths with the purpose of quantifying subsurface anisotropy, and formulate conclusions with the focus to delineate possible fracture locations.

The new service would help the client to better understand the subsurface heterogeneity of the data, leading to improved accuracy in interpretation. I gained a wealth of experience in using data processing software and expertise with Linux-based operating systems.

Working for PGS gave me real industry experience, a familiarity with the type of work I am looking for, and opportunities to make important decisions whose effects will benefit the company.

Gary Scherer

An internship experience such as mine, is available to all students attending the Colorado School of Mines. The rigorous academic standards, excellent reputation, plenty of job opportunities, and hands-on experience in the form of field camp are just some of the important qualities of a CSM education—which is "worth its weight in gold."

US Bureau of Reclamation
Surveying the Options

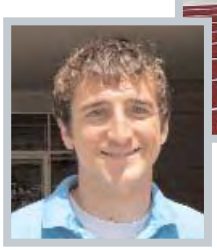
– Dan Liechty

Eight months ago, after receiving an email from Terry Young about an open internship at the Federal Bureau of Reclamation, I found myself sitting in an interview room on the tenth floor of building 67 in the Denver Federal Center with members of their geophysics team. Two weeks later I had an annual salary, a paid-in-full summer field camp, financial aid for geophysics classes, and the opportunity to travel anywhere in the western seventeen states to perform geophysical surveys for the Bureau of Reclamation.

My summer travels took me as far west as Sacramento, California, doing Wenner surveys in 110-degree heat in the central valley, and as far north as the Big Horn Mountain range in southern Montana, performing borehole investigations inside the Yellowtail Dam. Not the most welcoming environments for geophysical investigation, but beautiful as they were harsh.

Back in classes and currently putting in ten hours a week at the Bureau, travel opportunities have been put on hiatus. But with summer approaching fast, more adventures and painstaking travel itineraries are just around the corner.

Working for the Bureau, helping manage water resources in the western U.S. has proven challenging, demanding, and very rewarding. This specific opportunity in water resource investigation and management represents the exact reason I chose geophysical engineering when I came to Mines four years ago. I could not have asked for more.



GP student Dan Liechty (above foreground) is a member of both the CSM track and CSM cross country varsity teams. In November 2007, the men's team placed 7th out of 24 teams at the NCAA Division II National Cross Country Championships

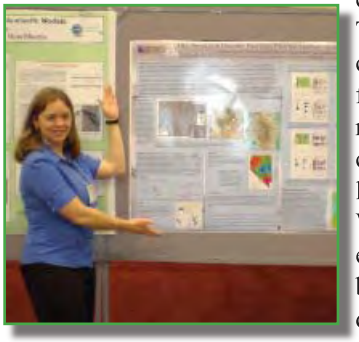
IRIS

Experience of Anomaly

– *Arianne Dean*

As part of the IRIS Internship Program (Incorporated Research Institution for Seismology), I had the opportunity to conduct research with Anne Sheehan, professor of geophysics at University of Colorado. All ten IRIS interns first met at New Mexico Tech in Socorro for a week of training. Besides making great contacts with each other and with professionals, the interns learned valuable skills for their internship.

My project with Prof. Sheehan consisted of looking at approximately 400 seismic events that were recorded by 30 short-period stations in the Southern Great Basin Digital Seismic Network in Nevada. A receiver function was created for each event and from this the crustal thickness in the area was calculated.



Arianne Dean at the AGU.

There is a large gravity anomaly in the area and we hoped to determine if the anomaly was due to a change in crustal thickness. The crustal thickness map showed that there was little-to-no correlation with the gravity anomaly.

As a conclusion to the internship, I presented a poster, "High resolution receiver from the South Great Basin, Nevada,"at the Fall 2007 American Geophysical Union meeting in San Francisco.

Lunar and Planetary Institute

Studies of the Red Planet

– *Jeremy Brown*

Off to Houston for the summer! This was my first thought as I learned that I had been accepted to a research internship at the Lunar and Planetary Institute and NASA Johnson Space Center. It seems that every geophysicist must "go through Houston" at some point in his/her career and this experience convinced me the statement is true.

My research project was focused on the "Volcano topography and apparent viscosity of the crust on Mars." To gain a better understanding of crustal deformation on Mars, this project sought to place constraints on the crustal viscosity of the planet using the volcano topography.

Most studies related to volcano deformation on Mars assume the crust is elastic/elastic-frictional. The studies that have considered viscous deformation have been in relation to either the crustal dichotomy or the large impact basins. Whether or not these areas yield any measurable or detectable viscous deformation is still under debate.

Using the volcano topography (high topographic features that put a large gravitational load on the crust), allowed us to determine if there is in fact detectable deformation occurring on Mars. The volcanoes on Mars, unlike the crustal dichotomy and impact basins, have a high deviatoric stress and low viscosity, making deformation easier to detect.

A potential drawback to using the volcano topography is that the large stress and gravitational load create, in addition to viscous effects, elastic effects as well. I used a new program, a numerical visco-elastic model, which assumed a linear viscous behavior and a linear elastic behavior. This gave us an opportunity to simulate volcano deformation from an initial topography that took into account viscous and elastic effects.

Jeremy in a "clean suit" at the NASA Johnson Space Center Moon Rock Curation Lab

The lower bound found using the numerical viscous elastic model was very close to the lower bound found using the semi-analytical model. This project helped us to gain a better understanding of deformation on Mars. I learned that Mars is unique because we can determine the viscosity of the crust up to several billion years. This is not possible with the Earth due to plate tectonics and many active processes.

This experience was excellent. Not only was I able to take part in cutting-edge research in the planetary sciences, but it was very cool to have a NASA Johnson Space Center badge for the summer. I saw Mission Control and the Saturn V rocket used in the Apollo program, and I met amazing planetary scientists. Students usually associate Houston with the oil and gas industry. But, I learned that Houston has a booming engineering and planetary sector as well.

The Crater Experience

Volcanic Research

– Alicia Hotovec

This past summer, I spent two weeks living in the crater of an active volcano, performing geophysical surveys. Visiting volcanoes has never held a dull moment for me, and this visit to Mt. St. Helens was no exception.

The misson. The basic idea of my field project was to repeat a self-potential survey (SP) in the crater floor that was done in 2000 and 2001. At that time, the volcano had been dormant since the 1980 eruption and the 1980-1986 dome-building events. In 2004, the volcano became active again and is still building a dome to the south of the old dome.

Graduate student Alicia Hotovec is working on her MS degree under André Revil's supervision.

My goal was to determine whether or not the self-potential signal has changed from an eruptive to non-eruptive state. In addition, the scientists with me wanted to do a few TDEM soundings to get more information about the subsurface structure of the crater floor.

Preparing. Before heading to the volcano, I spent a week at the Cascades Volcano Observatory (CVO) working with USGS volcanologist Rick LaHusen building a long-term self-potential 'spider' unit. The unit essentially consists of a metal box with three legs that houses a small computer, lots of batteries, and even more wires. I planned to place the spider on the old dome and lay out three long wires with electrodes at the ends and then measure the electrical potential between the three points. Wiring, assembling, and programming the unit taught me a lot about the advantages and disadvantages of building my own equipment.

Discovering the challenges. I was accompanied during the project by Paul Bedrosian (from the USGS Federal Center, Denver) and Matt Burgess (a master's student from California). After a day spent buying and packing 500kg of supplies, we met the helicopter that would transport us. We separated our supplies into three nets (slingloads)—and then we waited for the fog to lift before we finally took off.

Paul and I were the first on the mountain, followed by two of the three nets. Then, the fog rolled back in—stranding us in the crater with only partial supplies. We had a water supply, but no water filter; food and a stove, but no gas for the stove; solar panels to charge batteries, but no batteries. I had a sleeping bag and warm clothes, but no mats; and Paul didn't have either. The fog soon turned to cold rain. Thankfully, in the morning we were joined by Matt and the remaining supplies.

We set off across some pretty rugged terrain for the field site that was nearly a kilometer away from camp. We hiked up and down ravines with packs weighing anywhere from 20 to 40 kg. After the first few days, we got smart and left the heavy equipment in the field.

Getting to work. We spent the first week laying out wire loops for TDEM soundings, which was a bigger chore than expected. When Paul was on St. Helens in 2001, the crater floor was generally flat with moderate changes in topography. In the six years since then, glacial melt has deeply incised the crater floor, creating wide ravines aligned generally north-south. This made laying lines east-west very difficult. We only acquired about 40 loops. Matt will use the TDEM data to build a hydrologic model of the crater floor.

Taking self-potential measurements was the next and easier task. Because Jeff Wynn, chief scientist of the CVO Volcano Hazards Program, arrived to assist us, we were able to split into two teams and cover twice the area.

The benefits. Once Jeff and Matt returned to the CVO, Paul and I finished up measurements on the dome. There is something to be said about sitting at the base of the dome of an active volcano and realizing that the volcano is not your greatest enemy: It is the glacier. After years of snow and rock fall, a U-shaped glacier has formed around the dome in the crater. The two arms of the glacier have been slowly moving toward each other, and that day I was sitting between them. The noise and vibration were frightening at times, as large chunks of ice and rock caved in, falling in our general direction. We survived though battered, dirty, and sore. I've never been quite so happy to have a shower.

Division II 2007 USA Cycling Collegiate National Champions

The Challenge of the Trail

"Pedal, Pedal Pedal . . ." ***– Iris Tomlinson, GP Junior***

My passion for mountain biking began at age eight when my father bought my first mountain bike. It took him some time to convince me that the pink one with streamers wasn't exactly practical, so I settled for a purple Diamondback. That same year, I was in my first community race, competing against those who were 8-18 years of age. Ironically the first place winner was an 18-year-old, and the second place winner was an eight-year-old — me. I have been riding ever since then. When I came to CSM for my freshman year, I knew two things: I wanted to be a geophysics major and I wanted to be a part of "Mines Madness," CSM's cycling club.

During the race season, the club competes against regional schools such as CU, CSU, Mesa State, Fort Lewis, New Mexico, and Wyoming. To compete in Nationals, a team must be one of the top three in their regional division. So in October 2007, at number one in Division II for our region, the team piled into a van for a 23-hour drive to Banner Elk, North Carolina, with "NC or bust" scribbled on the side.

Because CSM has only been recognized as a cycling team in the collegiate racing community for five years, we were determined to surprise everyone. We were at our best advantage because it was the first time the team had three women competing in all events: downhill, dual slalom, short track, and cross-country.

The cross-country race was first, and the one I was most nervous about. I had trained in dry climate, but in Banner Elk it had rained for an entire week before the race, leaving four inches of sticky, muddy single track. My tires and chain were so caked with mud that I had no choice but to throw my bike over my shoulder and run the course. It was the hardest, wettest, funniest, and most exciting race I have ever completed, and I was ecstatic to place eighth out of over 25 women. Next was the downhill event: I crashed down the mountain, breaking my front wheel and landing on my face in a muddy creek. Luckily, the men on our team dominated, and were the loudest, craziest riders on the course.

At the dual slalom, the last event of the weekend, we were dead even with Warren Wilson College of North Carolina. With the anticipation of a national championship in the air, I screamed literally all day, cheering for my team. After a full day of BMX-style racing, and a nasty fall by our top male rider, we were anxious about the results.

When the totals were finally posted, there was an immense rush and clamor by the teams to view the results. I heard our president shout, "We're number one!!!" Immediately our team dog-piled on top of each other, mud and all. It was an incredible day for the team, the school, and a geophysics-bound little girl who spent most of her time riding in the wilderness encouraging herself to just "pedal, pedal, pedal."

The Lure of the River

– Elise Goggin

"I sat there and forgot and forgot, until what remained was the river that went by and I who watched . . .

. . . Eventually the watcher joined the river, and there was only one of us. I believe it was the River."

A River Runs Through It
Author – Norman Maclean

ELISE GOGGIN is a geophysics junior from Colorado Springs, Colorado. In addition to her studies in geophysics and her other interests, Elise is a starting guard on the CSM varsity women's basketball team and was recently placed on the Academic All-Rocky Mountain Athletic Conference team.

As a student athlete at Mines I find my schedule to be pretty full, but when I manage to find a Saturday free of wave equations and lay-ups there is one thing that I love to do: fly fish. I've been fishing ever since I was a little girl and I can't remember a time when I didn't love it. Up until high school my trips were few and far between and they usually consisted of early morning drives to the reservoir with my dad for a day full of spin casting from the shore. This all changed one Christmas when there was a new fly rod with my name on it under the tree. Now you can't keep me off the river!

I don't know if it is because I'm a female or what, but for some reason people can't picture me as a fly fisher. I've come to conclude that most people just have a false impression about the sport. They either picture the stereotypical old man just throwing out some bait, opening up a beer, waiting for a nibble, or some guy with a vest full of unnecessary gadgets waving a neon line around in the air. These are definitely not fly fishing!

Fly fishing is a challenge and it is all about technique and a carefully planned strategy. You have to pick the right line, the right leader, the right tippet, the right weight, the right flies, the right location, and the right fish. Instead of waiting for the fish to find your worm on the bottom of a lake, you have to find a hungry fish and present it with something that looks natural and appetizing, and then you have to catch the fish before he figures out that he just ate feathers and twine with a hook. Believe me this is not easy.

The reason I love fly fishing so much is because when you're on the river your mind has to be focused at all times. As soon as it begins to wander, that five-pounder waiting in the bottom of the pool is sure to strike, and if you don't set that line right away, he's a goner. There is no time to worry about the homework that is due on Monday, or the bad pass you made in the last game, it's just you and the fish and nothing else matters.

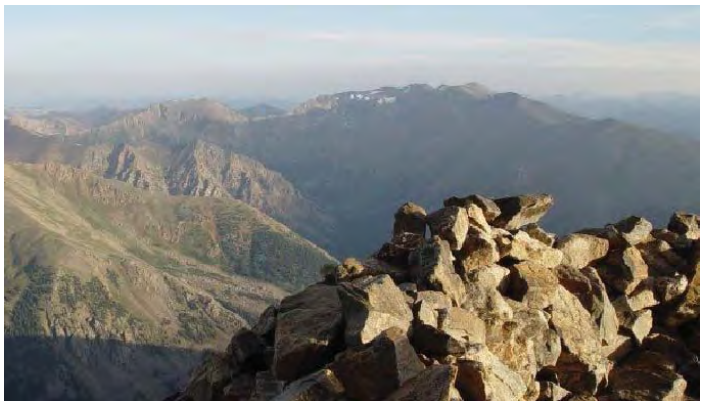
This summer I was able to get out to the river at least once a week. I fished the Blue River outside of Silverthorne and near Breckenridge a lot, but when I was short on gas money, Clear Creek suited me just fine. Yep, you would never guess it, but I've pulled about forty fish out of the creek right in downtown Golden.

As I frequented the same rivers again and again I decided it would be a good idea to write down details about my day, so I started a log that — for those of you who know him — would even make Dr. Olhoeft proud. I record weather conditions, water temperatures, flow velocities, flies that worked, flies that didn't work, fish caught and whatever else I think of at the time. My ultimate goal is to build my success rate at these locations. (Yes, I do go to Mines!)

I could go on and on about why I love this sport, but I think I've made my point. I love the hunt, I love the peace of mind, and I love being in the great outdoors. For me there is nothing better than a day on the river.

An uphill Battle

A Lesson in Perspective



— Jeff Godwin with rebuttal by Rebecca Johnson

Editor's Note: Two separate articles were submitted to the editor describing this Colorado climbing adventure. In the interest of space and fairness, and because we do not know which is the official version (i.e., the truth), only excerpts are printed here. Rebecca's rebuttals to Jeff's version appear in red.

Rebecca reacts strangely to the thin air at the Mt. Elbert summit.

J: One Saturday in August Rebecca Johnson and I, along with other friends, embarked upon a perilous journey to summit a peak of monstrous proportions. A peak so tall, and so scary, that not one of us was absolutely confident of our success. However, we left my apartment complex with a somber sense of purpose in our upcoming clash with destiny. We would either summit Mt. Elbert (the tallest mountain in Colorado), or die trying!

The hike would be nine miles and 4700 vertical feet from the trailhead. In spite of my reservations, we set off from Golden around 5:00 PM, heading into the wilderness along I-70 for a nighttime summit. Contrary to reports, my driving was safe and in control at all times.

R: Jeff drove like a maniac.

J: Upon arriving at the trailhead, we noticed a sharp drop in the temperature. As leader, I had made the wise decision to leave our tents behind, since they would only slow down our rapid ascent. We rolled out our sleeping bags and drifted off to sleep, not at all affected by the fact that the ambient temperature was a mere 10 degrees.

R: We spent four restless, rainy hours in sleeping bags in the middle of a hard, gravel parking lot.

J: I vaguely recall hearing shrieking and unfounded accusations that I had not planned properly. Since most of the group was not able to sleep through the intermittent showers, we began our climb at 2:00 AM. The trek uphill was arduous, but our morale was high.

R: Freezing and sleep deprived, we donned winter coats and headlamps and began our ascent. We hiked and hiked. Then the trail went downhill and we lost most of the elevation we had gained. Discouraged, we hiked still more. At one point, Jeff almost got us lost.

J: Eventually we hit tree line, which is around 11,000 feet, and found ourselves under the stars.

R: We wrongly thought we were above tree line on at least three occasions before plunging back into the forest.

J: I mustered my troops for the final 3000 vertical feet and we trudged onward, much to the chagrin of some members who by this time were whining at a high pitch. The trek reached its pinnacle around 12,000 feet when we abruptly left some of the group behind in a frenzied rush to reach the summit. We were determined to make it by sunrise!

R: I never have had, and never will have, a desire to see sunrise. I was thinking instead about being home in bed.

J: After some trickery on the part of the mountain involving false summits, the true summit was within our grasp. Exhilarated, we pressed onwards, and I was the first to summit. It should be duly noted, that I had to carry Becca up the last part of the mountain in a herculean effort of strength. How was I rewarded?

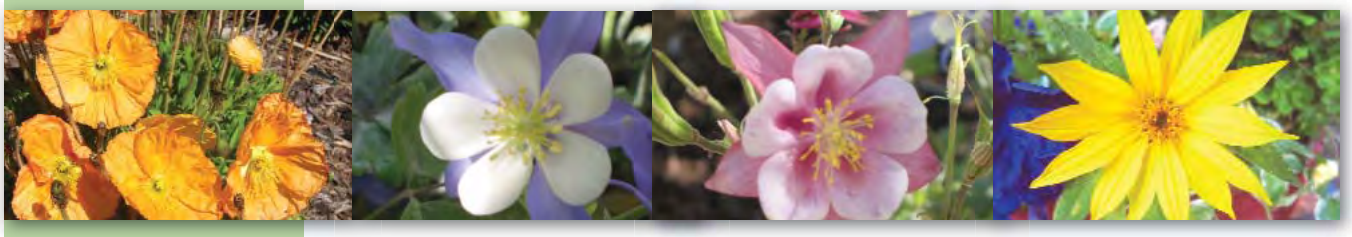
R: Jeff was complaining more than me at this point, but he was far enough behind that I couldn't hear him.

J: Becca promptly began choking me for dragging her up this "infernal" mountain; however, deep down, I know she loved having reached the summit, and would thank me later.

R: I was tempted to throw Jeff off the mountain, but instead I harassed him during most of the descent by reminding him what an awful idea it was to go on a nine-mile hike in the middle of the night.

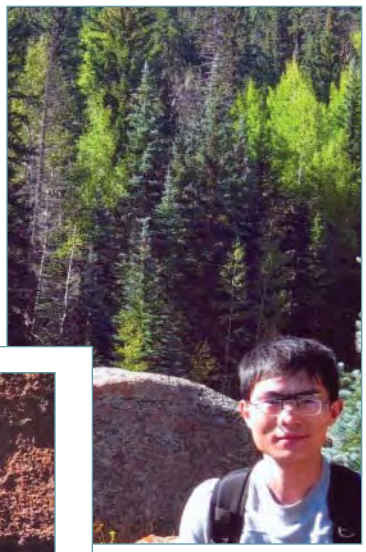
Postscript: To date, Rebecca and Jeff remain as friends and plan to climb together again. Only next time, Rebecca will do the planning!

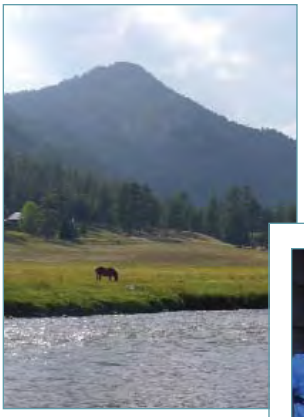
New Graduate Student Welcome Retreat



Nature Immersion

Our graduate students often arrive in Colorado from far away places, and so it has become a tradition to rapidly introduce the newcomers to the beauty of Colorado as well as to their fellow students. To achieve that purpose the Society of Geophysics Graduate Students (SGGS) is host to an outdoor weekend retreat at the Nature Place Center in the Rocky Mountains. The students return to campus from the team-building experience, ready to tackle their first semester.





Good Sports

Recreation Center Adds New Dimension to Student Life

Eat, sleep, and study — those words (not necessarily in that order) nearly say it all about CSM student life. However, the new state-of-the-art recreation center, which opened in August 2007, has added another dimension to the campus.

Besides expanded space for varsity competition (seating for 2,500), the new building includes a two-story atrium and rock climbing wall, an elevated jogging track, a well-equipped fitness lab, multiple use spaces for classes (such as yoga and aerobics) or intramurals and club sports, and a juice bar and lounge.

Perhaps the most obvious improvement is the natatorium, which includes an 8-lane 25-yard pool, with one- and three-meter diving boards, a CSM logo-shaped hot tub, tiered spectator seating, and glass walls providing natural light and a great view.

The additional space has allowed for expanded intramural and club programs, increasing opportunities for physical activity on campus.

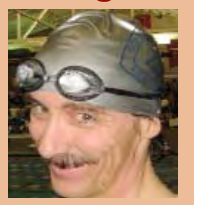
In 2004, CSM students overwhelmingly approved funding from student fees for the facility. Additional donations made this campus improvement a reality.

GP Students Exercise Mind and Body . . .

An informal survey of geophysics students about campus sports participation produced almost immediate response from 34 students (they love their sports). We have seven students that compete on CSM varsity teams (Division II, Rocky Mountain Athletic Conference).

The GP survey highlights the breadth of the intramural and club sports activity of our students. Many participate in multiple sports, both on and off-campus.

. . . and don't forget the faculty



Dave Hale

In my role as faculty advisor for the CSM swim team. I occasionally swam exhibition events, (including one 1000 IM) during Mines swim meets this year. But, my NCAA eligibility expired long ago, so I began to act my age and entered my first masters swimming competition in February. This spring, I was the only member of the Mines Masters competing in the Colorado Masters Swimming State Championships. My most important results are that I (1) swam my first-ever 1650-yard free-style, (2) lowered my most recent 100-yard freestyle time by a second, and (3) did not injure myself.

Indoor Soccer

The Downside of Victory – Hamad Al Ghenaim

GP student Hamad, displays proof of his soccer team's hard-fought victory.

Just one example of the enthusiastic participation of students in the newly expanded CSM intramurals and club sports program, is that of GP student Hamad Al Ghenaim. Hamad's indoor soccer team, "Samurai," claimed the tournament championship during the Fall semester league competition.

The Samurai team members did not know each other prior to the start of the season and it took a few games to learn each other's style of play, but they soon developed a reputation for being unstoppable.

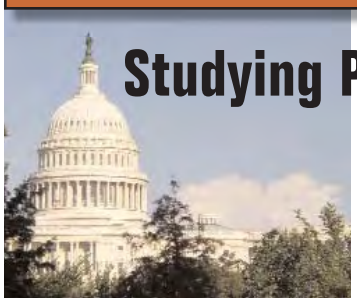
The final game of the league is the only one during the season that the Samurai found to be truly challenging. Everything before that was "just a piece of cake, " according to Hamad. During the first half of the championship game, the Samurai scored easily. Hamad and his team did not realize that the real challenge would come in the second half.

During a play in which Hamad was running to intercept the ball, he fell to the ground with his palm open, causing what was later diagnosed as a scaphoid fracture.

In spite of the injury, Hamad continued to play. He managed to assist the last two goals, resulting in a 4-3 Samurai victory. The pain in Hamad's wrist was temporarily forgotten as he celebrated with his team.

Following surgery, physical therapy, and time, Hamad will be ready and eager for the next season.

The Guy T. McBride, Jr., Honors Program in Public Affairs for Engineers



Studying Public Policy: The technical vs. the ethical

– *Colin Melvin*

Graduates of the geophysics department have probably heard about the numerous opportunities that await them. A geophysics major opens the door to careers in petroleum, mineral, and water exploration. Environmental applications such as containment mapping, volcanology, and UXO detection are also viable options.

While these are great choices for new graduates, there are also roles for geophysicists in public policy. This is especially true for those who enroll in the McBride Honors Program. McBride students complete 24 semester hours in seminars and off-campus activities to receive a minor in public affairs.

One of the classes in the McBride curriculum is a study in US Public Policy that includes analyzing a bill and visiting Washington, DC. Students in this seminar class choose a bill that is debated on the floor of Congress. They conduct research by interviews with senators and representatives as well as political and special interest groups to understand the issues around the bill. These interviews give students a first-hand experience with the policy making process.

In addition to research is the chance to visit Washington and the government offices that advise policy makers. One such office is the National Academy of Science. The National Academies are organizations of distinguished scholars in science, engineering, and medicine that further their disciplines with an eye towards the general welfare. Policy analysts often call upon them for expert advice.

The National Academies have many domestic and foreign positions as well as honorary memberships. Dr. Warren Hamilton, GP Distinguished Senior Scientist, is one such honorary member of the National Academy of Science.

If geophysics graduates prefer to work for a particular branch of the government, they can either work for the Office of Science and Technology Policy (OSTP) or the Congressional Research Service (CRS). OSTP is an office in which scientists and engineers advise the president on scientific issues and acts of law. CSM geology professor Dr. Murray Hitzman has served the OSTP to provide advice on natural resources.

If the geophysicist prefers the legislative side of the government, they can work at CRS. CRS provides unbiased research and facts on proposed legislation. They are often called to testify at house and senate committees and subcommittees when new bills are introduced.

GP student Colin Melvin (seated, 2nd from left) and others in the McBride Program US Public Policy seminar meet with the National Academy of Sciences in Washington DC.

Public policy opportunities are many in the federal government; however, there are policy roles in industry as well. For example, while completing a practicum at bp, I met an engineer whose job was to design and oversee the construction of equipment that would comply with emissions regulations.

The geophysicist or engineer in industry can be in a leadership role to analyze and influence public policy in the areas of compliance, regulation, and ethics.

The McBride Program's goal is for their graduates to recognize that engineering and scientific problems have social implications and that pure technical problems rarely exist. And in so knowing that, the graduate is able to act to promote the general welfare.

The 'Greening' of CSM

GP students Michael Mitchell (left) and Sarah Devriese (right) with team partner Jordan Portillo are also participants in the McBride Program. As part of the program's Cultural Anthropology semester, this group studied "how 'green' is the CSM campus." The team looked at recycling and environmental issues in the Mines Park residential complex.

For geophysics students, exploration relates mostly to discovery under the earth's surface. However, for some, exploration also relates to the discovery, through travel abroad, of the diversity of sites and cultures above the earth's surface. Here are a few such adventures.

Study ABROAD

A Semester in Hong Kong

— Nathaniel Cockrell

Nathaniel at the Great Wall.

Nearly a year ago, I enrolled in a Mandarin Chinese language course at CSM. This course taught me the very basics of the language and culture of China. It also piqued my interest in their society enough to convince me to study abroad for a semester.

During Fall 2007, I spent four months living, eating, and studying at Hong Kong University (HKU). These months were very enjoyable and enlightening, and brought me a new understanding and appreciation for the differences between the Chinese culture and that of the United States.

I learned much more about the habits and lifestyles of the average Chinese citizen than ever could be learned through books. I stayed in a dormitory, sharing a room with another foreign student from Michigan. We both met and became good friends with several local students. Everyone I met at HKU was exceedingly friendly and willing to spend time getting to know me and to help me in any way possible.

Beyond the time at the school, I did as much traveling as possible. The most astonishing trip I made was to Beijing where I spent a long afternoon hiking the Great Wall of China and the next few days exploring the city of Beijing and the Forbidden City.

The pure size and concentration of people within Beijing make it the most diverse and unique city I have been to and with more history than I could possibly absorb during my short visit.

If I have the chance to return, I would love to spend more time in Beijing, and then head to the rural parts of mainland China to expand my understanding of Chinese life outside the city.

A Long Trip to the Land Down Under

— Dylan Connell

The University of Adelaide Commons.

The first semester of my sophomore year led me to the University of Adelaide in South Australia. The semester got off to a rough start, as I missed a connecting flight, which caused me to miss my pickup at the airport. This resulted in my lugging two large suitcases through downtown Adelaide on a Sunday afternnoon (everything was closed) amidst the winter Australian rain. I spent three hours searching for the University office and suffering from extreme jetlag. Just when I had decided to leave the university grounds in search for a hotel or hostel, my eye caught sight of a bright red security sign tucked away on the far side of the courtyard. The door was open, and as it turned out, this was exactly where I needed to be. That night I was set up in my apartment and the next five months turned out to be the best of my life. Through all the new people I met, rowing, beaches, wine tours, site seeing, volleyball, cricket and footy watching, rugby, pub crawls – and classes, it was truly a memorable experience.

Dylan and the Sydney Harbor Bridge.

Study ABROAD

Aubry at Machu Picchu with Huayna Picchu in the background.

Peru: An Expanded Classroom

— Aubry Bingham

During the summer between my sophomore and junior years, I was lucky enough to take a Spanish class. I had taken two Spanish classes before, but what made this particular class different is that I spent three weeks in Peru, traveling with my classmates to almost every corner of the country.

One of the first things we did was to fly over the Nazca Lines, which are geoglyphs created by the ancient Nazca culture and visible only from the air.

I saw the ancient burial grounds of Sillustani, adobe temples, and I glimpsed the Andes Mountains. I traveled to the region of Puno, where I floated on the highest navigable lake in the world (Lake Titicaca), and saw floating islands and Bolivia in the distance.

I spent time in Cusco where I visited Qorikancha—an Incan temple with a church built right on the temple foundations. It was at Cusco and Sacsayhuaman that I experienced the local Inti Raymi, a winter solstice celebration.

The most amazing part of this visit was to travel through the Urubamba Valley, take a train to Aguas Calientes, and finally to visit Machu Picchu, "The Lost City of the Incas." Though breathtaking in pictures, it is unbelievable in person.

Dancers in Cusco during the Inti Raymi.

The days I spent walking through those Incan ruins are ones I hope never to forget. I enrolled in the Spanish class on a whim, and it ended up taking me half-way around the world.

Sharing the Opportunity to Learn

— Chris Engelsma

This past winter break I traveled to Mexico with the Mines Circle K Club. Typically, a trip to Mexico would involve lying on a beach enjoying everything the sun can throw at you, or at least that's what I've heard. On this trip, we went to build a schoolhouse and help renovate a church for a small town located just outside Tijuana.

I enjoyed this trip in many ways because it was a great opportunity to help out, while working on my construction skills, which were very much in need of a touch up. The trip provided a break from the stresses of school, and the feeling from helping others was remarkable.

There were several things that caught me by surprise while in Mexico. Of course, I was surprised to find out that, because there is no Cuban embargo in Mexico, Coca-Cola distributed there actually contains real sugar, rather than corn syrup. But this is not the surprise I was referring to.

The fiesta — entertaining the children.

The people in Mexico were perhaps the friendliest that I've ever encountered. One night, we held a fiesta for some of the kids in town at a local church. The fiesta involved different games our group had set up and various piñatas that we had stuffed. The kids were so excited to see us and just play with us, that it made the entire trip worthwhile.

When we presented the new schoolhouse, the looks on people's faces were amazing. Wherever we went we were greeted with smiles.

As for other engineering students, I face having to make a choice between pursuing a purely science field or finding personal contentment elsewhere. In most cases I have to choose my studies over other interests. Trips like mine to Mexico, help to ground us.

Hopefully after I leave school, I will be able to make a difference to others. I'm not going to cure any diseases or become president, but I hope that I will be able to help out however I can. If I don't succeed at that, then my time spent at Mines will have been in vain.

Mike Batzle, Director of the Center for Rock Abuse, and his field-camp friend, Jack the Mule. (Mike is on the left.)

THE Center for Rock Abuse is in the basement of the Green Center, where research continues whenever the jackhammerers rest for a moment during the remodeling project. Our center is now shared with the Department of Petroleum Engineering where co-director, Manika Prasad is an associate professor. Our research covers a wide range of the properties of both fluids and rocks, primarily for energy exploration and production. The eight students in the group work on such topics as heavy oils, carbonates, overpressure, gas hydrates, oil shales, condensate behavior, and anisotropic stresses. An example of the diverse investigations is the clay and shale analysis being conducted by Arpita Pal-Bathija.

Squeezing Rocks

CENTER FOR ROCK ABUSE

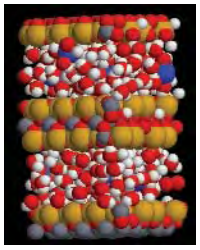
Since 1994

Clays and Shales: Still a Frontier

– Arpita Pal-Bathija

Since shales are the most abundant sedimentary rock on earth, and clays are present in abundance in shales, the elastic properties of clays are of utmost importance in soil science and geophysics . (Note that our seismic signals spend most of their lives travelling through shales.) Polymer, paper, ceramic, medicine, automobile and other industries also use clays in various ways. Our current primitive knowledge of clay and shale properties is rather embarrassing considering their abundance and importance.

The elastic properties of clays are being studied experimentally, analytically, computationally and by hybrid techniques. The major challenges in measuring elastic properties of clay minerals are due to their small grain size, ease of reactions with polar molecules, and low permeability. Most researchers have reported the mechanical properties of clays when mixed with other materials. The Young's moduli for clays reported in literature vary between 0.15 GPa and 265 GPa. This large variation may be due to various kinds of clays, different external environments leading to varied amounts of cations and bound water in the interlayers or anisotropy owing to the layered structure of clays.



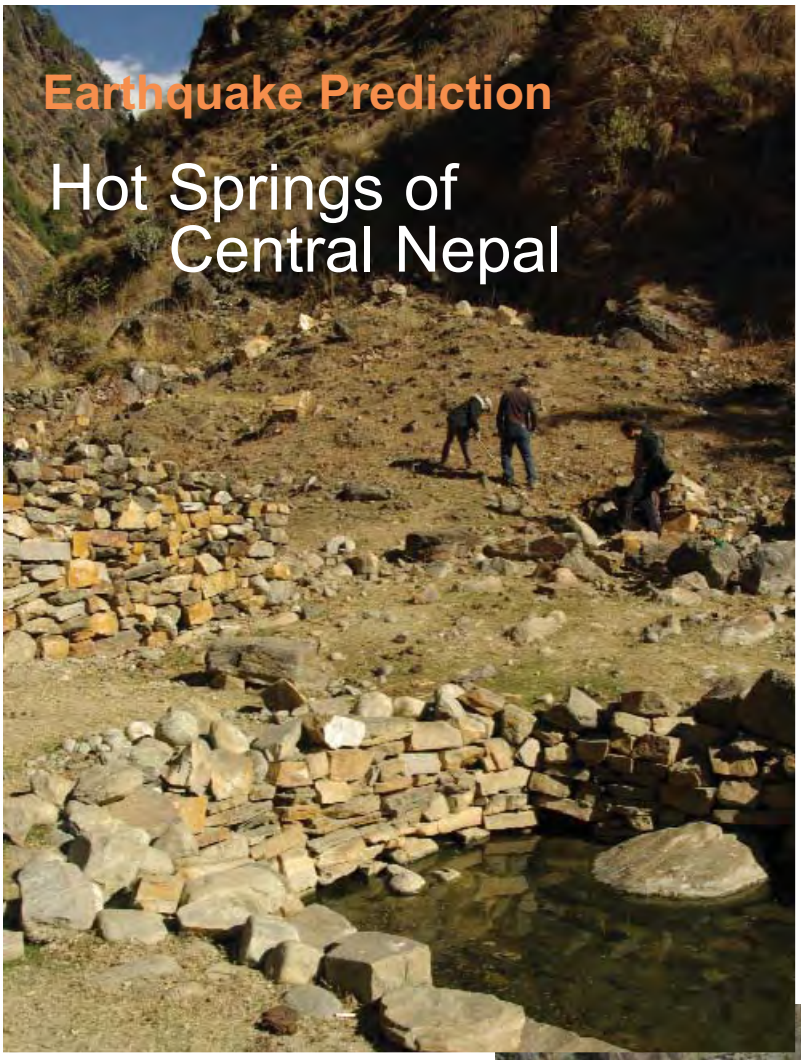
It is possible to abuse rocks in the computer as well as in our load frame: gold represents Si atoms; white, H; red, O; green, Mg; blue, Na; and grey, Al.

We are using a multi-method approach consisting of 1) molecular simulation on montmorillonite, with varying amounts of water content in the interlayer under different stress conditions; and 2) nanoindentation measurements on various reference clays, where a sharp indenter is loaded onto a sample and its response gives its mechanical properties.

Most researchers follow just one method, but the combination of modeling and experiments offers insights and assists in the interpretation of new results. Also, it is hard to quantify the amount of water in the interlayer in our nanoindentation measurements, but it is perfectly feasible in molecular simulation. The stress level in the experiments is also a tiny subset of what we can do in simulation. But experiments let us compare, verify and understand the simulation results.

The equilibrium state from one of our simulation runs for a stress of 1 GPa applied normal to the two clay layers, each containing four unit-cells in the X direction and two unit-cells in the Y direction, for four layers of water in the interlayer is shown in the figure.

Ultimately, this combination of physical measurement and computational techniques will allow us to understand and predict in situ shale properties, which is essential for the interpretation and modeling of their seismic response. Our quest for the knowledge of shale properties is underway and and we have a long way to go.



Earthquake Prediction

Hot Springs of Central Nepal

Hot Spring of Chilime

HOT SPRINGS IN NEPAL are widely known by the local word Tatopani. Over the last few years, André Revil (CSM, Dept of Geophysics), Fréderic Perrier (IPGP), Patrick Richon (CEA), and Svetlana Byrdina (IPG-Clermont-Ferrand) have been working with the geologists and seismologists of the National Seismic Centre of Nepal (Department of Mines and Geology of Nepal directed by Som Nath Sapkota), monitoring the activity of the hot springs of Syabru Bensi and Chilime, located in the Main Central Thrust zone in Central Nepal, a tectonically active area. Measurements have included a variety of geophysical methods (resistivity, radar, self-potential) and geochemical characterization of the waters of these hot springs. We were especially interested by the degassing of carbon dioxide and radon-222 and very high values of fluxes were measured in association with these hot springs.

Our goal was to point out a potential relationship between seismic activity and release of carbon dioxide and radon-222 in this area. The carbon dioxide is produced in the mantle and the mid-crust by metamorphic decarbonation reactions and escapes through fault zones.

Variations of the stress regime affecting these faults can modulate these fluxes. Radon exhalation flux is expected where there is rock deformation associated with fluid transport and earthquakes. Release of radon-222 was indeed observed in groundwater during the preparation phase of the Kobe earthquake (Igarashi et al., 1995).

The long-term goal of this research is to see if the variation in the flux of radon could be used as an earthquake precursory signal, and therefore if it could be used, ultimately, for earthquake prediction. To make progress, it is important, in tectonically active sites like Central Nepal, to better understand the physics of radon exhalation in association with carrier fluids, in particular carbon dioxide.

André Revil (right) working with Nepalese colleagues on the hot spring of Chilime, near the Tibetant border.

– André Revil
Associate Professor of Geophysics
Colorado School of Mines

Colorado School of Mines

Center for Gravity, Electrical & Magnetic Studies

Non-seismic adventures in the Department of Geophysics at the Colorado School of Mines: Research update

*Kristofer Davis†, M. Andy Kass‡, and Richard A. Krahenbuhl**
Center for Gravity, Electrical, & Magnetic Studies: CSM

Editor Review

Members of CGEM are so engrossed in research that they submitted their report in journal format.

Abstract

For those unfamiliar with CGEM, the Center for Gravity, Electrical, and Magnetic studies is a 'sleeping giant' among the more established research centers in the Department of Geophysics at CSM. Focused on education and research in the fields of gravity, electrical, magnetics, and electromagnetic methods, the group is currently comprised of an associate professor, a distinguished senior scientist, a post-doctoral fellow (recently appointed to research assistant professor), a visiting scholar, six PhD students, three Masters students, and a couple of undergraduate students.

Introduction

Over the past year, the members of CGEM (Figure 1) have demonstrated the research equivalence of ADHD, constantly moving from project to project as new and exciting ideas pop into their heads, but managing to stay to the bitter end of each. This activity is all fueled by a lead investigator/advisor holding an endless pot of coffee in one hand, a bullwhip in the other, and a little resolve and fortitude. Over the past year alone, our members have tackled research topics associated with, but not limited to, those listed in Table 1.

Research Motivation

The Center, an umbrella corporation with a PO Box in the Bahamas (Guggenheim Hall, really), is actually comprised of multiple sources of funding spanning different categories of research, thus allowing for an eclectic collection of research projects. An important component of CGEM is the Gravity & Magnetics Research Consortium (GMRC), which allows our students and faculty to travel from conference to conference presenting research that benefits the energy exploration and mining communites.

A more recent source of research ideas and funding for CGEM is the US government's Strategic Environmental Research & Development Program (SERDP) – a joint program between the Department of Defense, the Department of Energy, and the Environmental Protection Agency. We find bombs – literally! And we're good at it. How cool is that!

Figure 1: Members of CGEM, overall, taken in April 2007. One or two members are missing in the photo, but that's what happens when one moves to Houston before defending one's thesis.

Results

Many exciting events, both personal and professional, have taken place for CGEM members recently. On the personal side, practically every student (and post-doc) of CGEM has become either engaged or married within just over a year.

The professional experiences for our group have been equivalently exciting. To begin, Dr. Yaoguo Li recently taught a course on applied geophysical inversion at the China University of Geosciences in Wuhan, China, during his Fall semester sabbatical. While claims of a hidden agenda cannot be confirmed, e.g. recruiting new members for the ranks of CGEM and the Department, Dr. Li also gave a number of presentations at a university in Beijing, a research institute, and a resource company in Seoul, Korea.

Traveling just as far, three of our members recently represented CGEM and the Department while presenting their research at the Australian Society of Exploration Geophysicists (ASEG) conference in Perth, Western Australia. The talks were well received, and the members were thus awarded a little time off, which they spent touring the beautiful countryside of Western Australia to sample the local 'grape juice.' Results are illustrated in Figure 2.

Several members of CGEM likewise presented talks during the 2007 SEG meeting in San Antonio, Texas. At the same conference, a special workshop on 4D gravity monitoring was co-chaired by Yaoguo Li. A 4D gravity presentation was given at the same workshop by one of our students. Another talk on 4D gravity methodology was presented at an Educational Session of the National Groundwater Association's (NGWA) Groundwater Expo'07 in Orlando, Florida. Also in Orlando, two different members of CGEM presented talks at the UXO/Countermine/Range FORUM 2007.

The SERDP-funded project associated with these talks, which is led by members of CGEM and jointly performed with the University of British Columbia, Sky Research, Inc., New Mexico Institute of Technology, and Michigan State University, received SERDP's distinguished Project of the Year award. In addition to this project, SERDP has just approved three new major research projects associated with UXO investigations, to begin Spring semester of 2008. Lastly, associated with current and future SERDP projects, members of CGEM have made several trips to Washington D.C. to present and defend the projects to the Scientific Advisory Board and Technical Panel for SERDP.

Figure 2: Investigations into the subtle differences between Shiraz and Syrah. Results demonstrate that the Australian versions tend to be much more intensely fruit driven than the French Syrah, with less hard-edged angularity in youth, despite possessing significant amounts of tannin and characteristic peppery spiciness.

Discussion/Conclusions

Over the past year, there have been many exciting growth fronts for CGEM on personal and professional levels alike. First, the members have successfully submitted and defended a number of high quality proposals, both research and marriage in scope. And the future for CGEM demonstrates promise as the members prepare for a spree of publications, conference presentations, start of new projects, influx of new blood into the group, and a series of comprehensive projects and thesis defenses.

Table 1: CGEM Research Topics

- groundwater monitoring
- simulating soils exhibiting viscous remanent magnetization and their EM response
- imaging cargo containers at the nation's ports for fissile material with gravity gradiometry
- monitoring reservoir dynamics with time-lapse gravity data
- detecting unexploded ordnance (UXO) in highly magnetic environments
- identifying subsurface archaeological structures
- inverting magnetic data that are strongly affected by self-demagnetization
- constructing more efficient model discretizations for faster inversions
- estimating magnetization direction for the remanent magnetization problem
- understanding the issues for fast and accurate terrain corrections to gravity gradient data
- processing transient electromagnetic data using equivalent source techniques
- modeling 3D surface NMR for hydro-geologic studies
- separating signal sources in TEM data using principal component analysis
- using multiple methods to characterize basement for basin-scale applications
- enhancing UXO magnetic data by stable downward continuation
- jointly inverting surface and borehole gravity data during water injection
- characterizing UXO remanence via a rotating coffee table with optical encoders

Acknowledgments

The younger members of CGEM gratefully acknowledge the influence of Professor Yaoguo Li and Dr. Misac Nabighian. Together, they have worked hard to build a healthy work environment where all the members of CGEM have learned to balance their research and productivity with personal development and a little friendly banter.

References

CGEM et al., 2008: www.geophysics.mines.edu/cgem (last updated January 2008).

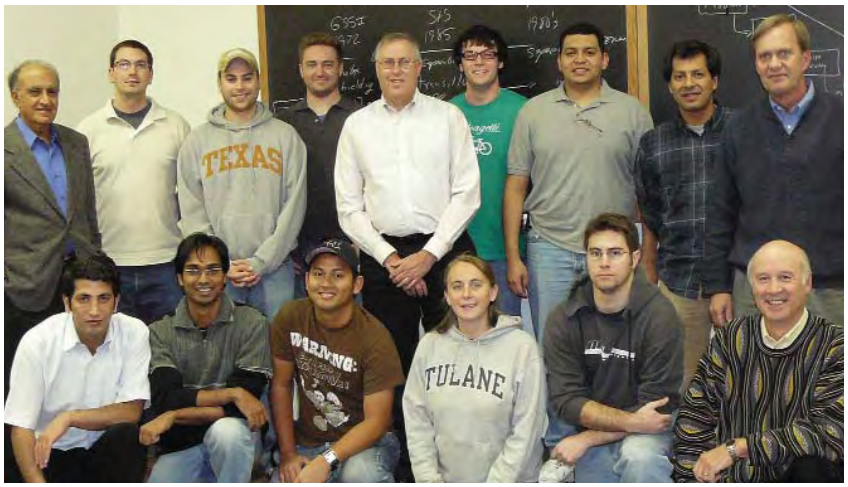
RCP Center for Reservoir Characterization

The Many Faces of RCP

– Sue Jackson
Consultant, Impact, LLC

The RCP at the School of Mines serves as a model of success in leveraging the strengths of diversity. The distinctive participant groups in the RCP each contribute to the success and strength of the consortium's mission in a unique and vital way.

Sponsors are a key to insuring the RCP is focused in technical areas of current interest to the industry. Tasked with actively selecting research projects and providing resources to help with the research, sponsors provide a sounding board for collaborative research. The relevancy and economic potential for the RCP's work in 4D and multicomponent technologies to model complex reservoirs is widely appreciated, especially as we consider using unconventional resources in the future.



RCP Director Tom Davis (lower right) and Associate Research Professor Bob Benson (upper right) huddle with students and sponsors during a weekly "game-plan" session.

The frequent interaction of the sponsors with students gives them a chance as hiring companies to see students perform in an environment similar to that of a company. RCP graduates are highly sought-after to fill the needs of today's robust industry climate.

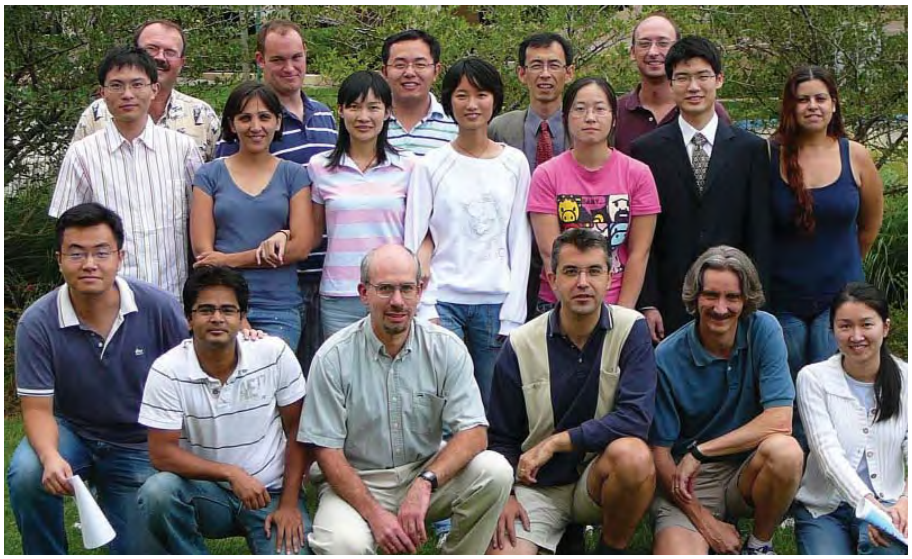
Students are the heart of the RCP program. They come from around the globe, attracted by the unique environment provided by the data-rich setting, working simultaneously with 4-D and multicomponent data. Although data management can be challenging, the students appreciate working in a team environment on open-ended integrated problem-solving. The rare opportunity to work with new acquisition data is a big draw, and no one complains about the potential to land a great job. Weekly student meetings keep them connected to each other and the integrated project.

Alumni are an important face of the RCP. Driven by loyalty to the program, a significant number of graduates remain affiliated with the RCP as employees of sponsor companies. In commenting on what best prepared them as students for employment, RCP alumni point to the interaction with sponsors, the applied experience of working with their own data, and the emphasis on developing analytical reasoning skills that the RCP presented to them. Alumni acknowledge that their preparation for presentations for the sponsor audience and discussions with sponsors provided excellent experience in learning how to leverage other people's knowledge and develop networking skills. No other school is as focused as Mines in promoting critical thinking skills, according to one RCP graduate.

Mentors are yet another face of the RCP, and represent a clear and vital strength of the program. Industry mentors are generally sponsors and/or alumni. Some are RCP board members. The giving of a mentor's time and experience is driven by their vested interest and sense of responsibility for training the next generation. Industry mentors are positioned to give unique guidance from a corporate and practical perspective. The demands of the RCP program at times stretch the effectiveness of professors, and mentors can augment the help of a thesis advisor.

Consortia in general continue to play a vital role in the education of the next generation of technically trained oil and gas specialists. In the case of RCP, the diversity of faces and their commitment to the program results in continued evolution and success.

Sue Jackson, has been a consultant assisting RCP for many years. A member of RCP's Advisory Board, Sue has been commissioned by RCP to engage in a Scoping Study concerning RCP's future. Thanks to her hours of "listening" to industry reps, fellow board members and students, RCP's "game plan" is on-track.

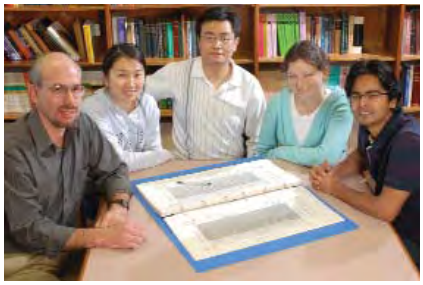


Center for Wave Phenomena Approaches the Quarter-Century Mark

– Ilya Tsvankin and Jennifer Nekuda Malik

For nearly 25 years, the Center for Wave Phenomena (**CWP**) has been on the forefront of applied seismology and today it continues to serve as a force in the development of more efficient petroleum-based energy technologies

The CWP research consortium strives to maintain a portfolio that is both cutting-edge and relevant to collaborative partners, while also supporting a premier graduate-level research and education program. The Center, which was founded in 1984, collaborates with the petroleum industry, government agencies, and academic institutions to carry out research in seismic exploration, monitoring and wave propagation. Founded by applied mathematicians Norm Bleistein and the late Jack Cohen, CWP conducts research combining mathematical rigor and computational sophistication with realistic representation of subsurface formations.



Professor Ilya Tsvankin talks over A(nisotropic)-Team research with several of its members.

CWP is devoted to the development of theoretical and computational methods for imaging the earth's subsurface to detect and monitor hydrocarbons. The main focus of the consortium is inverse wave-propagation problems and seismic data processing for complex subsurface models. Active CWP research topics include seismic imaging and velocity estimation using wave-equation techniques, seismic interferometry, anisotropic velocity analysis and imaging, multicomponent seismology, fracture characterization, and image processing.

A combination of industrial and government support provides a stable financial base for the Center. The CWP Consortium Project on Seismic Inverse Methods for Complex Structures is currently supported by 25 companies in the hydrocarbon exploration industry. CWP also receives funding from the DOE, NSF, Petroleum Research Fund of the American Chemical Society, USGS, ExxonMobil, Landmark Graphics, Shell and Statoil.

The industrial collaborations established by CWP also allow faculty and graduate students to work on joint projects with their sponsors. A recent industry collaboration between Mines' **Roel Snieder** and ExxonMobil employees, Mike Payne and Anupama Venkatarama, focused on using induced seismicity to monitor the steam behavior in a heavy-oil reservoir. Through the support of ExxonMobil, CWP attracted Masatoshi Miyazawa from Kyoto University in Japan to work on the heavy-oil reservoir project for one year.

CWP faculty members provide the program with breadth and notoriety: **Ken Larner** earned the Petr L. Kapitsa Gold Medal, the highest award given by the Russian Academy of Natural Sciences and the Maurice Ewing Medal, the highest award for lifetime achievement of the Society of Exploration Geophysicists (SEG); **Norm Bleistein** received an honorary membership from SEG; **Ilya Tsvankin** and **Dave Hale** have both received the Virgil Kauffman Gold Medal, the highest scientific award of SEG and **Paul Sava** has been honored by SEG with the Reginald Fessenden Award for his work on wave-equation imaging. Several former CWP students and postdoctoral fellows have received the SEG's J. Clarence Karcher Award for outstanding young scientists.

CWP faculty members have organized a number of high-profile international meetings and workshops. Currently, Ilya Tsvankin and Ken Larner, along with James Gaiser and Edward Jenner of ION Geophysical–GXT Imaging Solutions, are organizing the 13th International Workshop on Seismic Anisotropy planned for Aug. 10-15, 2008, in Winter Park, Colorado.

This article is excerpted from the inaugural publication of the *Colorado School of Mines Research* magazine. "Energy and the Earth" was the focus of the 2008 issue, edited by Jennifer Nekuda Malik.

GP Faculty Receive Honors

Paul Sava
SEG Reginald Fessenden Award

Paul Sava accepting the Reginald Fessenden Award from 2007 SEG President Leon Thomsen.

Paul Sava was honored with the Reginald Fessenden Award from the Society of Exploration Geophysicists during the SEG 2007 Annual Meeting in San Antonio, Texas.

The Reginald Fessenden Award is given to a person who has made an important specific technical contribution to exploration geophysics. Paul was recognized for his work on angle-domain wave-equation common-image gathers.

Paul joined the CSM faculty as assistant professor in the Department of Geophysics and the Center for Wave Phenomena in 2006. He earned a PhD in geophysics from Stanford University where he was a member of the Stanford Exploration Project. Among other honors, he is a past recipient of three Awards of Merit for best student presentations at the SEG conventions and of an Honorable Mention in the category Best Paper in Geophysics for "Angle-domain common-image gathers by wavefield continuation methods," co-authored by Sergey Fomel.

Warren Hamilton
GSA Structural Geology & Tectonics Division Career Contribution Award

Warren Hamilton, Distinguished Senior Scientist in the Department of Geophysics and retired Senior Scientist of the U.S. Geological Survey, was presented by the Geological Society of America with the 2007 Structural Geology and Tectonics Division Career Contribution Award. An excerpt from the award citation, written by Keith Howard, reads "Warren Hamilton's powerful and innovative contributions to the development of tectonic concepts have had major influence on the directions of our science, consistently breaking new ground and undermining entrenched old dogmas.

Warren's prolific career has time after time presented us lucid and perceptive syntheses setting forth new and long-lasting concepts in global and crustal-scale views of tectonic and magmatic processes. Warren's current debunking of deep-seated plumes ("they don't exist"), his proposals for a weak, plateless Archean crust, and his drastic reinterpretation of Venus as a low-heat-flow planet that preserves its early crust and impact basins pose only the latest of many bold challenges he has offered the structure and tectonics community."

Warren Hamilton

Yaoguo Li
SERDP Project of the Year Award

Yaoguo Li (right) receiving the SERDP Project of the Year Award.

Yaoguo Li, Associate Professor of Geophysics, led a team that was awarded the Strategic Environmental Research and Development Program (SERDP) Munitions Management Project of the Year Award at the 13th annual Partners in Environmental Technology Technical Symposium and Workshop in December 2007. The award was for work on the project, "Improving Detection and Discrimination of UXO in Magnetic Environments" of which Yaoguo is principal investigator. Other team participants are from the University of British Columbia, Sky Research, Inc., New Mexico Tech, and Michigan State University. SERDP is the Department of Defense environmental science and technology program, planned and executed in full partnership with the Department of Energy and the Environmental Protection Agency along with other federal and non-federal organizations.

Irresistable Combination

California Sunshine & Stanford Hospitality

– Ken Larner

Ken Larner's happy and comfortable retirement was rudely interrupted when he was kindly invited to spend the Fall quarter with the students of the Stanford Exploration Project (SEP) at Stanford University. He was to fill in for Biondo Biondi, who was on sabbatical presenting his worldwide SEG Distinguished Instructor course. Accepting the SEP offer with trepidation, little did Ken and his wife Nancy realize just how thoroughly they would enjoy their time in Palo Alto.

Nancy and Ken Larner on the Stanford campus.

Having learned much in his retirement, Ken decided to take a minimalist path while with SEP. He chose to augment the regular SEP seminar with a seminar of invited guests, each of whom would spend two days on campus, giving seminars and spending time with students. Ken's only remaining chore was to serve as host for lunches and dinners.

Although these seminars meant an additional time commitment for the students, overall they appreciated the exposure to a variety of advanced topics in reflection seismic research from noted research innovators and leaders in the field. In addition, Ken met weekly with each of the SEP students, wielding his red pen, especially for those homing in on their dissertations.

Ken and Nancy found time to enjoy the rich variety of food and pleasurable activities in the Palo Alto and San Francisco area. Among those activities was Ken's daily seven-minute bicycle ride to the office—something he never attempted between his mountain home in Evergreen and the CSM campus in Golden.

A former director of CSM's Center for Wave Phenomena (CWP), Ken noted that CWP and SEP have many features in common. Both projects have enjoyed longstanding industry-wide support — CWP for 24 years, and SEP for a remarkable 35 years. Both have 12-15 PhD students doing research in aspects of the reflection seismic method, with some overlap of interests. The faculty and students of the two projects have had various interactions over the years. In fact, two CWP faculty, Dave Hale and Paul Sava, are graduates of SEP.

More graduates of CSM than of any other university — including Stanford — have done their PhD study in SEP. Ken's visit is a step at further cooperation between these two research projects.

Prior to going to Palo Alto, Nancy wondered what she would do while Ken was working. It turned out that she was even busier than Ken, pursuing her art and writing. She found unexpected opportunities to network with people about her newly published children's book, *A Mouse in the Rabbi's Study*. (It seems that networking is a way of life in Silicon Valley.)

Ken describes his time with SEP's students as "pure joy." To Biondo, he says "Thanks for the wonderfully stimulating time you provided me at SEP."

Teachers Taught to Teach

– Steve Hill

During Summer 2007, department members Steve Hill and John Stockwell joined a troupe of other university faculty at the NSF-sponsored workshop, "Teaching Geophysics in the 21st Century." The University of Michigan geology camp, Camp Davis, near the Wyoming Tetons, provided the pleasant surrounding for sharing teaching techniques.

Steve and John reviewed for the group their advanced geophysics methods course on seismic processing. As part of their presentations, they showed processing results produced by their students.

By the way, a "troupe" is a group of theatrical performers (or geophysicists) having a good time while learning from each other.

CSM Flip-Flop: Student to Teacher

Chuck Oden

This year the Department welcomed Dr. Chuck Oden as an adjunct faculty member. Chuck is an expert in electromagnetic wave propagation and in the instrumentation used to measure electrical and electromagnetic fields. He has considerable expertise from his previous employment with Nebraska Radio Telephone Systems, Mount Sopris Instrument Company, the USGS, and Mercury Geophysics.

Most recently, Chuck has a "day job" as Director of R&D at Earth Science Systems, LLC, where he is exploiting nanotechnology to create acoustic, electromagnetic and electric instrument arrays. Chuck earned his PhD in geophysical engineering at CSM under the supervision of Prof. Gary Olhoeft.

Chuck dove right into team-teaching the junior-level class, Theory of Fields II – Time-varying Fields.

GRADUATES

GP 2007

Robert Blanchard, Alicia Hotovec, Meagan Stephens and Alison Meininger.

Joseph Romani

Nathan Hancock

Jordan Dimick

Mohd Shahir Mohd Adnan

Trevor Irons

Spring Convocation

BS, Geophysical Engineering

Robert Henry Blanchard II
Brianne Douthit Hamm
Nathan Taylor Hancock
Matthew Phillip Hergert
Alicia Jean Hotovec
Trevor Paul Irons
Lia Maree Martinez
Alison Jean Meininger
Mohd Shahir Mohd Adnan
Alex Omar Olsen, Jr.
Joseph Andrew Romani
Meagan Renee Stephens
Bryce Alan Swinford
Matthew John Wisniewski

MS, Geophysics

Eldar Guliyev

MS, Geophysical Engineering

Gerardo Jose Franco Lugo

MS, Hydrology

Neal Jordan Dimick

Professional Master, Petroleum Reservoir Systems

Christopher Kelly Taylor

GRADUATES

GP 2007

Winter Convocation

BS, Geophysical Engineering

Aaron Joseph Girard
Earl Richard Marshall
Jonathan Paul Parker

MS, Geophysics

Whitney Elizabeth Goodrich
Amy Lorraine Hinkle
Jared Roy Peacock
Robert Brent Riley
Begoña Ruiz Piñeiro
Elmar Safarov

MS, Geophysical Engineering

Matthew M. Silbernagel

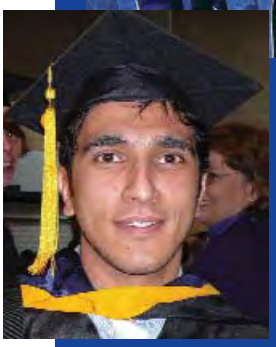
Professional Master, Petroleum Reservoir Systems

Berat Niran Tasdemir

PhD, Geophysics

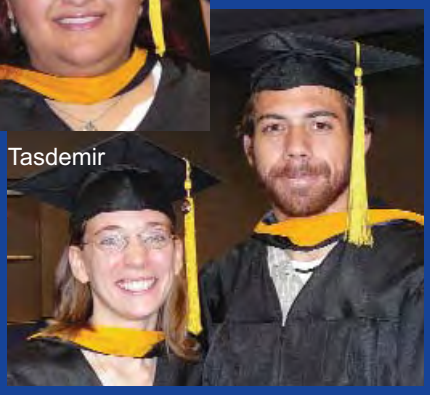
Lauri Ann Burke
Barry Kirkendall
Kurang Jvalant Mehta
Ivan Jazotte Vasconcelos

Ivan Vasconcelos, Kurang Mehta, Barry Kirkendall and Lauri Burke.



Elmar Safarov

Niran Tasdemir



Whitney Goodrich and Jared Peacock

Jon Parker, Earl Marshall and Aaron Girard

GP faculty dressed for Winter Convocation 2007: Department Head Terry Young, Yaoguo Li, Roel Snieder, Max Peeters, Ilya Tsvankin and Gary Olhoeft.

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Colorado School of Mines
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