geophysics

Colorado School of Mines

Spring 2011

geophysics

Spring 2011
Colorado School of Mines

From the Department Head

Greetings from the Department of Geophysics! We are pleased the Geophysics newsletter has found its way into your hands and we are sure you will find it both informative and enjoyable.

We invited our undergraduates to write articles telling us how they discovered geophysics and decided to major in it. In some cases, we have included their entire articles; in others, we took excerpts from their articles and sprinkled them throughout the newsletter. You will enjoy their responses!

As in previous issues, we have included highlights of graduate research activities, a recap of summer field camp, photos from graduation, and feature articles on cultural experiences of faculty and students traveling to and from Golden. Special features in this issue are a section on women in Geophysics and some highlights of our growing interaction with the United States Geological Survey (USGS).

This newsletter marks a changing of the guard. In 2010 we celebrated the careers and retirements of Barbara McLennon and Susan Venable. Barbara gets credit for the marvelous layout and publication of all of our previous newsletters. We are grateful that Dawn Umpleby has picked right up where Barbara left off, producing this 2011 newsletter.

Enjoy!

On the cover

December 2010 Geophysics PhD graduates: Yuanzhong Fan, Rituparna Sarker, Jia Yan. Photo by Barbara McLenon.

Celebrations of Service:

Barbara and Susan Retire!

John Stockwell, Dave Hale, Barbara McLenon, Paul Sava, Terry Young.

Barbara McLenon joined the staff of the Colorado School of Mines as an independent contractor hired to perform publication-related work with the Center for Wave Phenomena (CWP) in 1985. CWP at the time was an interdisciplinary research group consisting of 4 mathematicians, Norman Bleistein, Jack K. Cohen, John De Santo, and Frank Hagin, and "publications" involved typing papers laced with equations on a clunky word processor called a "North Star Advantage". CWP was officially in the Math department at that time.

Over the subsequent 26 years, as CWP moved from the Math Department to Geophysics, and the faculty of CWP changed twice, Barbara's skills expanded to typsetting, web page design, and the production of the newsletters of CWP, and of the Geophysics department, as well as the publication annually of a 300-page-plus book of papers written by members of CWP. Barbara's skills in graphic arts, her inventiveness, and competence transformed the public face of both CWP and the Geophysics Department.

Raising three daughters during her time here prepared her for her unofficial role as "Mom" for many of the graduate students. Barbara's human touch in CWP and the Geophysics department, her wit, kindness, and friendship are perhaps the greatest assests that we will miss.

~ John Stockwell

Susan Venable rocked her way to retirement in 2010. During the 2010 RCP spring meeting Susan was invited to sit in a rocking chair with a Mines logo and a plaque on the back that said “Have a Rockin’ good time – from all your friends in RCP”. Considering that I had to assemble the chair moments before we gave it to Susan, I was surprised and thankful that it held together on its inaugural run!

Susan and her husband Stan moved down from Fort Collins 8 years ago to be closer to their daughter. She wanted to keep active and did so by joining us to handle the administrative side of RCP and to work with the Department. As in any 50 – 50 sharing plan she soon found out it was more like 100 – 50 and there were never enough hours in the day. Being the conscientious soul that she is, she found working 12 hour days enabled her to get by. Eventually though she came to her senses and one day said “I quit”. That was another shock for yours truly.

We miss Susan and she fesses up to the fact that she misses us – but only just a little. She is busy with grandkids, projects, cleaning out the basement from the move, and this and that. She does admit that at the end of the day she likes sitting on her front porch, rockin’ away.

~ Tom Davis

Tom Davis, Michelle Szobody, Susan Venable, Stan Venable, Terry Young, Bob Benson

Why Geophysics?

This spring undergraduates were asked to write about why they chose geophysics as their major. Their answers are on the following pages, and in the "short takes" spread throughout this edition.

Paying the Toll - My Road Trip to Geophysics

While attending college there is one question that you will have to answer on a fairly regular basis. "What is your major?" I have found that over the past few years of answering this question I have been met with the same confused looks. Not many people know what Geophysics is and how it plays a role in their everyday lives. In fact I wasn't aware of the subject until my junior year in high school. The path I have taken has been a bit like a road trip. I have taken wrong turns, changed directions, and payed a variety of tolls along the way, but now that I'm finally here in my second year at CSM and actually taking classes dealing with my major, I've realized it was all worth it.

It's been an odd journey, especially since I don't even know why it started but I do remember how. In the second grade my teacher read the class a book about the city of Pompeii and the massive volcanic eruption that occurred. Soon after I was hooked. I reread the story over and over again during our reading hours, unable to get enough information. I was introduced to another aspect of geophysics in the fourth grade when we viewed a movie about plate tectonics. I can distinctly remember my reactions to the film. I was completely terrified and absolutely fascinated at the same time.

I slowly began to change directions as my interests shifted over the next few years into the meteorological sciences, focusing on tornados and major thunderstorms. My new goal in life was to be a tornado chaser and I was in the perfect place for it. I lived in St. Louis, MO and was quite often witness to extreme weather patterns. If there was a storm I would be outside for as long as possible. This usually meant until my dad decided it was time for the both of us to get inside and away from windows, and settle for just watching The Weather Channel instead.

I traveled along this detour for quite some time, that is until I was reintroduced to geophysics via a literal road trip. My family camped in Yellowstone National Park during the summer of my freshman year in high school. At first I wasn't excited about the trip but after our first day of hiking around the geyser basins I was one happy camper. As we spent our days exploring I soaked up as much information as possible and flipped on my turn signal. It was about time to merge back on the geophysics highway. I spent the next several years researching and learning all I could about Yellowstone and now had a goal in mind. I wanted to learn all I could and someday be able to research the area and everything that was happening there.

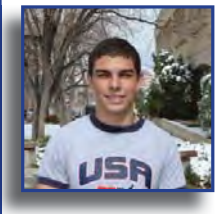
Now that I had a goal in mind it was time to lay on the gas. I was done with high school the minute I walked through the doors on the first day so I chose a different path. I attended the Missouri Academy of Science, Mathematics, and Technology in Maryville, MO for my junior and senior years and worked through all my general education classes. While there I decided it was time to figure out where I would go to reach my end destination. This is when I finally figured out what Geophysics was and found my new home, Colorado School of Mines. After visiting with my dad (and getting over my qualms about the "Howdy Folks!" sign in downtown Golden), I was set on attending Mines.

For the next few months it was all work and no play. I was driving on the windy backroads through rain and snow in my attempts to finish my classes, graduate and be accepted. I managed to complete my tasks and was set to attend Mines in the Fall of 2009. I had assumed that since I had sped through high school and the start of my college career that I would be able to jump right into my major but little did I know that there were still a variety of toll booths ahead. I have now slowly made my way through a year and a half worth of general education classes. I have hit a variety of road blocks along the way, some pushing me to the point of reevaluating why I am here, but the fact of the matter is I have found my way back to the main road. This semester I am in several Geophysics classes and I can finally see how these classes will help me in the future.

I might still be traveling down the road but at least now there is an end in sight. I have yet to decide exactly what but I know that each day I'm getting closer and closer to what I've been striving to reach for many years.

~ Liz Maag, GP Sophomore

Wrestling Geophysics



I came to Mines with my heart set on mechanical engineering and nothing was going to change my mind. That was until a series of events slowly led me to geophysics. At the Celebration of Mines I saw a booth that said "Geophysics". I said to myself, "How cool would it be to say to people that I am a geophysicist," but that was the extent of me wanting to join the department. I then had Earth and Environmental Systems where I started appreciating how cool the earth was. I decided to talk with Dr. Shorey, the professor for Earth and Environmental Systems, to see what major would better suit me. I expressed how I loved physics, geology and math and he pointed me in the direction of geophysics. As I researched more and more about geophysics I began to see what an incredibly fulfilling life I could make out of this major. That same day I went down to the registrar's office and changed my major to geophysics. Besides geophysics, I have another passion, wrestling. I am on the Mines wrestling team and we sometimes miss a day or two of classes, but my geophysics professors are very understanding of what I do and allow me to make up work I missed and catch up on notes I may have also missed. Geophysics is a small department so the professors get to know you very well. I am not just a random person who came up to the professor after class one day saying I am going to miss Friday's quiz. Between wrestling and geophysics, I would say my life at Mines is interesting and definitely a lot of fun!

~ Elias Arias, GP Sophomore

The Future Energy Resources Minister of Thailand

After exposure to off-shore seismic and gravimetric analyses at an exploration and production site in Thailand, I became facinated with exploring combinations of alternative energy and my passion for physics and mathematics. The chance to combine all these interests spurred my curiosity, so over the next two years I tried to immerse myself in the study of geophysics. The next year I participated in a drilling site workshop and used various types of wave generators to explore beneth the ground's surface. Day after day, I discovered pieces of my future dream and career.

In 2007, my curiosity regarding 2-dimensional waves and vibrating plate patterns, used to simulate the Pacific plate's motion, allowed me to win the scholarship from the national physics JSTP (Junior Science Talent Project) to develop this project with Professor Narin Nuttavut at Mahidol University. My world of geophysics broadened further when I experienced computational geophysical lab analysis, and gained international perspectives as a German exchange student.

What causes a tsunami? How do Pacific plate motions affect earthquakes? When will petroleum become obsolete and no longer be used to power mankind's vehicles? The more I questioned the nature of the world's cycles, the more facinated I became with the complex physics equations which could answer my queries. But, there is no experiement, no professor, and no college to teach me geophysics in Thailand. Therefore, I strived for education abroad. At the Colorado School of Mines Geophysics Department, I have begun to find answers to my questions. Geophysics not only has the potential to answer pressing challenges for my generation in Thailand, but it will prepare me for my future career in the South East Asia Petroleum Company. This study will shape my achievements and aspirations to be the Energy Resources Minister in Thailand.

~ Detchai Ittharat, GP Freshman

Unlimited Possibilities

Why study Geophysics? Geophysics is a science of unlimited possibilities. Research in this area not only covers our Earth, but beyond it, to our atmosphere and to other planets. Also, there are so many interesting things about Earth right around us, under our feet or just above us. The study of geophysics stretches from tectonic plates on the ocean floor to the Hawaiian volcanoes to the aurora borealis. That is what is so cool about this topic. It covers every aspect of what our Earth is, what is does and how it works.

I became interested in geophysics because I am such a fan of the outdoors. Growing up, I found a love for hiking, something about standing thousands of feet above the world is just an incredible feeling. Anyway, always looking at mountains and their magnificence made me want to pursue a degree that would allow me to study our beautiful planet or even planets beyond this one. I want to be able to learn about the Earth and find ways to put its raw energy and power to our (mankind's) advantage, while still maintaining its beauty. A career in geophysics can take you to some incredible places to make unbelievable discoveries. I have yet to hear of someone who has regretted pursuing a job in this area. What I specifically want to study, I'm not sure yet. All I know is I want to be involved in the wonders of our planet and solar system.

~ Allie Grazulis, GP Sophomore

A Washing Machine, A Computer, and EPICS2

When I was 13 years old I participated in many math competitions among elementary schools in my city. Then, I was chosen to go to math Olympics. I also participated in a science competition which I won for making a washing machine.

In 2000 I got an old computer that had a Windows 95 operating system. I started fixing my own computer, and then other family computers, gradually becoming familiar with most computer parts. After that I started using many graphic programs, such as Paint, Adobe Photoshop, etc., and then I started doing 3D modeling using some programs like 3D Max. In 2008, I received a scholarship to attend the Colorado School of Mines. Most of the people I knew were majoring in petroleum engineering. Every one of them tried to convince me how important the petroleum engineering major is because petroleum is the most important source of Saudi income. One can easily get a job and make a lot money. So I decided to major in petroleum engineering.

Last spring, I started taking petroleum engineering classes. Professors explained how important petroleum is in this world and how their students can make a lot of money. They did not talk so much about the importance of the knowledge we were going to learn. As a result of that, I started thinking about switching to a major with more science that is practical at the same time. After doing some research and reading about the majors at Mines, I discovered Geophysics.

Last semester, I took EPICS 2 with Dr. Dave Hale. That class was about programming, which was one of the first things I hoped to learn. During that class Dr. Hale showed us some of his geophysical work, which included processing data and turning it into a 3D image so you can see the oil and gas reserves. He turned geophysical data into a model that revealed unseen activities inside the earth.

What I am learning in geophysics right now makes me more excited about what I am going to learn in the future. Everything I hoped to learn when I was young I am discovering inside the Geophysical Engineering major.

~ Abdulhamid Almumtin, GP Sophomore

The Many Wonders of Geophysics

As I dive into my academic career in geophysics here at Mines, I am continually amazed by the multitude of applications of geophysics. Although geophysics used to be primarily used in the petroleum industry, this is no longer the case. Nowadays, geophysics is being used in forensics, archeology, and to detect unexploded ordnance. Geophysicists are also able to study the geophysics of other planets and geophysics is being used by civil engineers in their quest to improve structures.

Though sometimes the many options available to me to explore as a geophysist may be rather daunting, I also find it comforting and exciting. Today geophysicists are able to visit space, the ocean floor, travel back in time, and assist in solving some of the world's many mysteries, which is truly astonishing.

~ Jasmine Lambert, GP Junior

Area of Special Interest (ASI)

When I arrived at Mines to begin my studies as an undergraduate, I was already set on being a geophysicist simply because it sounded "cool". To fulfill certain requirements for assignments and projects in high school I had researched and examined what geophysicists do for a living, but at the end of the day my final reason was because the name was cool. Throughout the first semesters of undergraduate study I began to have doubts concerning my major, mostly because I had only taken geology classes and no geophysics classes. To settle the doubt, I spoke to my advisor and he pointed out the main differences between geology and geophysics and I decided to stick with geophysics and see how it would turn out.

Around this time Dr. Jeff Andrews-Hanna gave a lecture to the Planetary Geology class concerning Mars and how he applied geophysics in order to analyze the southern highlands and northern lowlands anomaly. For me, this was a pivotal lecture because it rekindled my interest in geophysics, and I started looking into an ASI (Area of Special Interest) in Space and Planetary Science and Engineering. After summer vacation, the real geophysics studies began with EPICS II, then Materials of the Earth and the Theory of Static Fields. So far I've discovered a lot about geophysics and now my interest in the field is stronger than ever.

Looking back on my three completed semesters at Mines, I think that people are the main reason I am studying geophysics. My professors' experience, love for their field, and genuine interest in their students' learning are the main reasons I am majoring in Geophysical Engineering with an ASI in SPSE. So I say kudos to all the Geophysics professors. Keep it t up!

~ Dan Shannon, GP Sophomore

From 90°F to -13°F: A Tropical Girl in a Frozen Golden

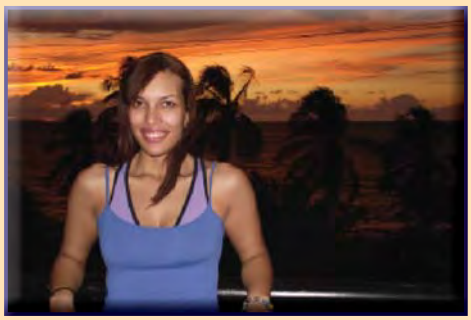
Nataly Zerpa, GP Graduate Student, Reservoir Characterization Project

When you meet a new person it is common to ask: Where are you from? In my case it is a difficult question to answer considering that I moved more than 29 times around Venezuela and the world.

When I received my letter of acceptance from Mines I was the happiest person in the world. It took me around three months to get all the paperwork done and to get my visa. Everything was ready for my trip to my new hometown. When I booked my flight I realized that I had to pack all my life in two pieces of luggage of 50 pounds each. It was hard to decide what to bring and what not to bring, but everything became easier when I opened my closet and everything I saw was summer clothes: swimsuits, skirts, tanks tops, summer dresses and sandals. I was not afraid of moving to a different country, but I was concerned about the weather. As soon as my plane landed I saw a white world waiting for me. It was the first time in my life to see snow. I remember my first impression: everything is white and white is an extremely boring color. I have to confess that the best advice I ever got was "Do not eat yellow snow".

My first day in Golden was a very cold one. I went to walk around and everywhere I received a smile from people I do not know asking me "How are you doing today?" At the beginning it was weird, but then I got used to it and now I like it. Golden is a very safe place where you just have to be aware of wildlife. I remember one day I was walking to the grocery store and I saw two mountain lions in front of me. I was so afraid! In five seconds I remembered all the T.V. shows I've seen in my life about animals that attack people. Nothing happened to me, but it is a good story to tell.

I spent last summer in Golden, and I have to say that it is a different place. I like it better because it is closer to what I am used to. It is simply beautiful and there are a lot of outdoor activities and things to do that you don't know where to start. The only thing needed to make Golden a perfect place is a beach. Since that is not possible I printed some pictures of Venezuelan beaches and put them on my desk.



From 300 Rainy Days to 300 Sunny Days

Hilde Haktorson, GP Exchange Student

I arrived in Golden on a warm and sunny Tuesday in August. It was scary to come to a new and foreign country and I was nervous, but luckily I was travelling with two girls from Norway who made my transition much easier. Overall, I was very excited for the new opportunity. The other girls had a place to stay in Mines Park, and unfortunately CSM was still working on finding a place for me. In the meantime I decided to stay at my friends' place. We arrived at campus and had no idea where to go or who to ask for help. Fortunately we met a really nice guy who helped us. He even gave us and all of our luggage a ride to Mines Park. It surprised us how open, attentive and helpful people were. Usually people from Norway are not that helpful to strangers. During my time here, I've noticed how warm and sunny it is almost every day. I didn't know much about Golden and Colorado before I came, but what I had heard was there is a lot of snow and temperatures are very cold. It is wonderful to come to a place where the weather is so stable; if it is sunny when you wake up, it is most likely sunny all day. This is not the case in Bergen, Norway which is where I come from. I have heard that there are 300 sunny days a year here, in Bergen it is 300 rainy days a year. I also enjoy all the squirrels running around campus every day and how spotting a deer is a normal occurrence. I've never been so close to wildlife before. I also really like the mountains in Colorado, both in the summer and winter. I love snowboarding and I go as often as possible. The snow is so much better here than what I'm used to, and I have already had a lot of beautiful days at Copper Mountain.

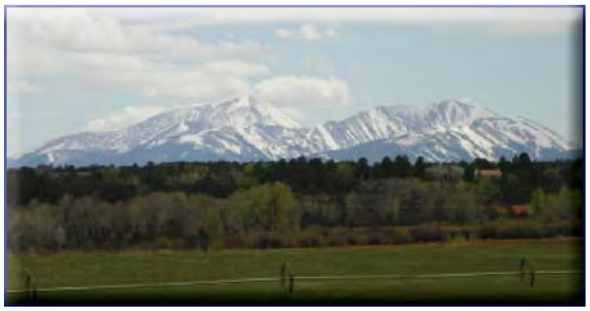
Camilla Sunde Gjengseth, Hilde Haktorson, Ida Ianssen Lundh

What I have also experienced during my time here are all the nice people. Everyone you meet on the street is nice, smiling and they often say hello to you. A big difference from home is that all the professors here know your name and talk to you if they see you. They are much more open and seem interested in how the students are doing. The professors back home might not recognize you in the hallway, and they definitely don't know your name. CSM also seems to have a good connection with companies and they often bring in people from the industry to give lectures. This is very motivating and I feel more ready than ever to go from being a student to an employee. I was actually supposed to be here for just one semester, but after being here and experiencing Golden for a couple of weeks, I decided to stay for two semesters.

The time has gone by so fast and I know that I am really going to miss this place and all the people I've gotten to know. This has been an extraordinary experience and I am truly happy I decided to go abroad one year, especially to Golden. I will remember this year for the rest of my life.

THE 2010 FIELD CAMP EXPERIENCE

-Ashley Fish, GP Combined BS/MS Student



If hiking seven kilometers up a narrow, mountainous trail while jug-hustling weren't insane enough, try hiking up a 45 degree slope of debris flow channels with rolls of resistivity survey wire on your back… at elevation.

Now, imagine being fortunate enough to be placed in these situations with fifty new faces from all around the world, with backgrounds ranging from material science to mathematics to geophysics. Further yet, imagine that such geophysics related mountaineering and rock climbing adventures would breed lifelong friendship and memories worthy of story time with your future grandchildren. This was Geophysical Field Session 2010, an experience to be remembered.

The goal of Geophysical Field Session 2010 was to understand the inner workings of the Upper Arkansas Valley's geological and hydrological systems; to locate and quantify potential geothermal energy resources within Chaffee County, Colorado.

The first two weeks of Field Session consisted of field surveys ranging from seismic to DC Resistivity, from SP to gravity and magnetics and covered the region from Chalk Cliffs down to Poncha Springs. We were placed in unfamiliar territory and were challenged to reach beyond our comfort zones.

The second two weeks of Field Session were designed for data processing and report writing. With the collaboration of Boise State, Imperial College London, and CSM faculty and students, we produced a quality, 220 page report outlining the geology and geothermal character of Chaffee County, Colorado.

Unbeknownst to my classmates and me at the beginning of Field Session, we would accomplish and experience much more than just a geophysical survey and analysis of geothermal activity in Chaffee County; much more…

Within the four weeks of Field Session, my classmates and I were presented with the invaluable opportunity not only to discover the quirks of applied geophysics but the opportunity to forge friendships, which I believe will last a lifetime. Exploring Zapata Falls, getting temporary "flyerfly" tattoos, gator wrangling, eating family-style dinners at the ranch, brewing Twinnings tea and cooking pasta on a camp fire, hiking miles while lugging geophysics equipment up mountainous terrain, watching our TA break-dance, sitting in the geothermal hot tub talking the night away under the stars, experiencing Dr. Bob's geologic tours, and listening to our Professor play the violin while writing reports 'till dark thirty, were all bonding experiences never to be forgotten.

The Planetary Geophysics Lab Explores Other Worlds

This has been a busy year for Jeff Andrews-Hanna and the Planetary Geophysics Lab. This past fall, the group grew to four graduate students and one undergraduate. Graduate students Brian Davis, Ezgi Karasozen, and Yaser Kattoum joined the group, as did GP undergrad Ryan Isherwood. We now have six people studying four planetary bodies: Mars, the Moon, Venus, and Saturn's moon Titan.

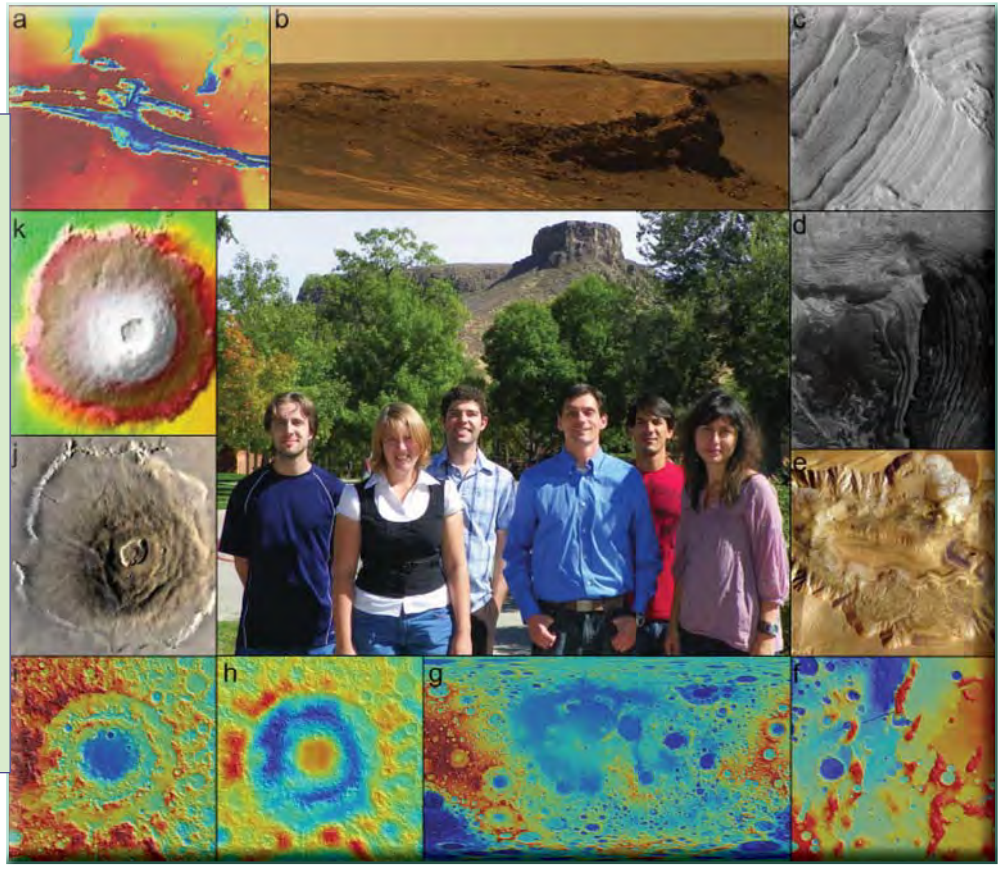
Jeff continues his research on the hydrological cycles of Mars and Titan, the geodynamics and tectonics of Mars, and impact basins on the Moon. One big research focus this past year has been the origin of the Valles Marineris canyons on Mars. These enormous canyons are up to 2000 km long, 200 km wide, and 10 km deep – much larger than anything seen on the Earth or anywhere else in the solar system. This canyon must have formed in a unique manner – and current research is investigating the confluence of factors that led to such a dramatic chasm on Mars. Another big research focus is on the history of water on Mars. Early in the history of Mars, it possessed an active hydrological cycle similar to that on the Earth today. A paper published in 2010 investigated this hydrological cycle in detail, focusing on the origin of an extensive set of evaporite deposits currently being explored by NASA's Opportunity rover. These deposits formed as groundwater rose to the surface and evaporated, leaving behind a thick stack of salt-rich sedimentary rocks. A follow-up study, now in press, looks at how the hydrological cycle of Mars changed over time as the planet's climate changed.

In related work, graduate student Kelsey Zabrusky is using a variety of datasets from NASA orbiters to reconstruct the original extent of these ancient evaporite deposits on Mars. Her work found that the deposits once covered a very large area of the martian surface, and the deposits being explored by NASA's rover are only a small remnant of the original deposits. She presented this research at both the Lunar and Planetary Science Conference (LPSC) and the Geological Society of America meeting, and placed 3rd in a graduate student research fair poster competition at CSM.

Brian Davis is using geophysical data to investigate the structure and evolution of Valles Marineris. By combining gravity and topography data, he is able to look below the surface at the deep structure of the canyons. Evidence suggests that at one time, the canyons were filled with thick sedimentary deposits, only a vestige of which remains today. The erosion and removal of these deposits would have had significant geophysical consequences for the entire region. Brian submitted an abstract on this work to present at the 2011 LPSC conference.

Ezgi Karasozen is investigating a very different tectonic province on Mars: the South Tharsis Ridge Belt. Mars is a very alien world in many ways, but some aspects of the planet look a lot like home. This belt of ridges on Mars looks very much like the basin and range province in the southwestern United States. Understanding how these ridges formed will shed new light on the geodynamic and tectonic evolution of Mars.

Yaser Kattoum is using gravity data to study giant impact basins on the Moon. The surface of the Moon is



The members of the Planetary Geophysics Lab, from left to right: Ryan Isherwood, Kelsey Zabrusky, Brian Davis, Jeff Andrews-Hanna, Yaser Kattoum, and Ezgi Karasozen. (Clockwise from top left) Valles Marineris (a, MOLA topography), the Cape Verde outcrop on Mars (b, Opportunity Rover image), sedimentary deposits in Becquerel crater and Sinus Meridiani (c, d; HiRISE images), the large sedimentary mount in Hebes Chasma (e, Viking image mosaic), the South Tharsis Ridge Belt (f, MOLA topography), the topography of the Moon (g, LOLA topography), the gravity and topography of the Orientale basin (h, i), and Olympus Mons (j, Viking image; k, MOLA topography).

dominated by impact basins – when you look up at the Moon at night, the dark spots you see are volcanic plains filling these impact basins. With the help of Yaoguo Li and Rich Krahenbuhl, he will be applying techniques currently being used in the exploration geophysics community to see what they will reveal about the sub-surface structure of these lunar impact basins.

Not to be outdone, the undergrads in the lab have been busy as well. In the first half of 2010, Joyce Hoopes assisted Jeff in research on the methane lakes of Titan. In the summer, Lauren Jozwiak from MIT joined the group as a summer intern. She spent her summer studying Olympus Mons on Mars, the largest volcano in the solar system. She used lava flows to reconstruct the paleotopography around Olympus Mons, in order to shed light on when the volcano formed. GP undergrad Ryan Isherwood is now continuing this work, by using geophysical models to study the deformation of the surrounding lithosphere that resulted from the growth of this volcano. Lauren and Ryan will present this research at the 2011 LPSC meeting.

~ Jeff Andrews-Hanna, Assistant Professor.

Rocks to Rockets: Why I Chose Geophysics

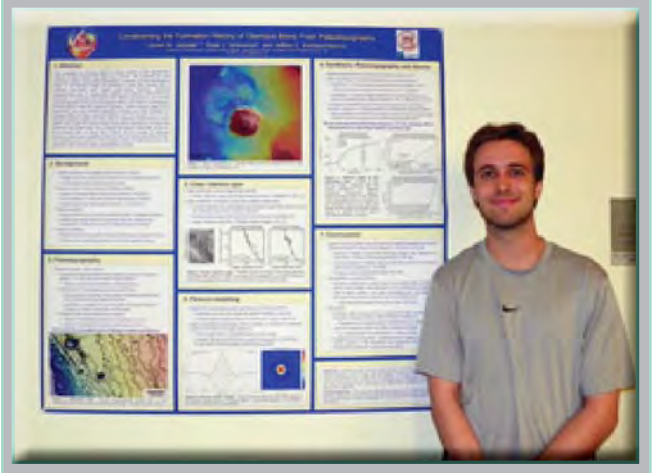
For the past three years here at Mines I had studied to become an exploration geologist. However, while sitting on a rock in Arches NP during week one of geology field camp, I realized that this was not the kind of thing I wanted to do with the rest of my life. Although I didn't know what I wanted to do at the time, I promptly went home and spent the next semester taking required core classes while deciding what I was going to do. Having already completed more than half of the credits towards the new Space and Planetary Science and Engineering ASI coupled with a lifelong passion for space and a natural aptitude towards computing, the decision was easy as I made the realization that geophysics was the place for me.

From being born nearly the same time as the Hubble's initial launch, to seeing the death of the ninth planet, my life has been enriched with a profound interest in what's out beyond the reach of our imagination. It can be said that although geology seems to be more about the what, where and when, my passions have always been more geared towards the why and how. That being said, it is easy to see how this interest is greatly paralleled by the geophysics core value of discovery and study of that which cannot be seen in order to explain process of that which can. From this, what greater place is there to study the unknown than bodies outside our atmosphere?

Now that I look back on my decision, I wonder why I did not make it sooner. It seems obvious to me now that after years of watching the night sky, countless hours watching and reading science fiction, and a still well rooted interest in the geosciences, geophysics was where I belonged from the start. I am excited to see how far this path will take me as I continue to study and look towards the sky

~ Matt Emmett, GP Freshman

Undergraduate Research: Planetary Geophysics



One of the most difficult things to teach a student is to think independently. One of the ways this is taught is through problem solving. This is often done through projects; advanced gravity and magnetics and digital signal analysis labs come to mind. However, all of this class work cannot compare with doing actual research. The idea of actually applying knowledge gained from classes to find out something useful is quite staggering the first time. With a typical school assignment there is a specific answer to get, with research there are only goals.

Personally this school year (2010-2011) has been the first for attempting this kind of problem. At first, the idea is extremely intimidating, since you are basically attempting to do something that has no known answer because few or no people have worked that specific problem. This is the reason for research advisors; they are there to help you with the thought process of what to do next and why, what papers to read, what goals to set and so on. Jeff Andrews-Hanna helped me with my research problem and he was amazing. Doing this type of problem by myself, at this point in my education, would have been extremely difficult, time-consuming and likely frustrating. Jeff however broke the problem down into smaller pieces and allowed me to attempt this sort of work in a situation where I still had a full time class-schedule.

In the end the answer achieved in the problem is not what is important (in fact it is still in progress) but rather what is personally learned. The experience from this will be useful for a long time, likely my whole career, and thus one of the most valuable things I could receive at this point in time. It is for this reason that I am thrilled that Colorado School of Mines has this type of opportunity for undergraduate students. Because of this and the experience that I have had in the various classes at this school, I am glad that I choose to come to this university and specifically to this department. It has, thus far, been a wonderful and interesting ride even if it can be bumpy sometimes.

~ Ryan Isherwood, GP Senior

Studying *Wave* Phenomena

SEG "Best Paper in Geophysics" Award

Dr. Jyoti Behura and Professor Ilya Tsvankin were presented SEG's "Best Paper in Geophysics" Award at the SEG 2010 Annual Meeting in Denver. "It is an impressive achievement for Jyoti to receive this award for a paper written when he was in graduate school," states Tsvankin, Jyoti's Ph.D. advisor. Jyoti completed his degree in May 2009 and is a geophysicist with the Imaging Research and Development team of BP America, Inc., Houston.

The paper, "Role of the inhomogeneity angle in anisotropic attenuation analysis," presents a thorough treatment of a complex wave-propagation problem with far-reaching implications in seismic inversion. The possible influence of the so-called inhomogeneity angle (the angle between the directions of wave propagation and maximum attenuation) on attenuation coefficients had long confounded in¬version and interpretation of seismic attenuation measurements even in isotropic media.

The fundamental result obtained by Jyoti and Ilya for arbitrarily anisotropic media is that the group attenuation coefficient measured from seismic data is practically independent of the inhomogeneity angle and reflects the intrinsic attenuation of the material. This conclusion provides a basis for using directionally-dependent attenuation coefficients in fracture characterization and lithology discrimination.

Dr. Jyoti Behura, CWP graduate;
Dr. Steve Hill, SEG Past President and CSM Adjunct Associate Professor;
Dr. Ilya Tsvankin, Professor, CWP.

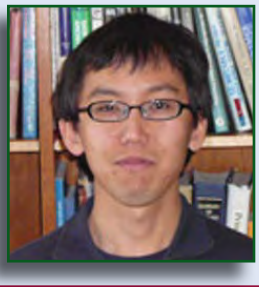
Perth Harbor

14IWSA = A Great Journey

~ ***Mamoru Takanashi, PhD Candidate,***
Center for Wave Phenomena

It was the longest journey of my life: I flew to the other side of the globe, from Denver to Perth, Australia, traveling on five different airplanes for a total of 30 hours, with one flight delay on the way from Los Angeles to Brisbane. Still, it was worth the effort to travel to Perth in April, 2010 for the 14th International Workshop on Seismic Anisotropy (14IWSA).

Perth, which is known as one of the top-ranked cities for liveability, is beautiful, warm, safe, and offers great seafood. Another important characteristic is that it is the capital of the most resource-rich state in Australia, and a large portion of the natural resources is exported to my home country of Japan. I would like to devote myself to research relevant for the regions from which Japan imports oil and gas.



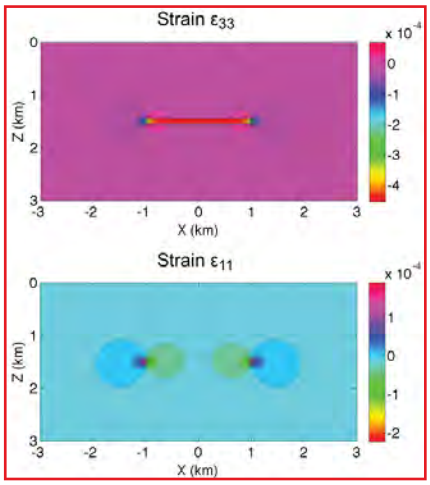
The meeting attracted more than 80 geoscientists from Australia and all over the world. It was a good opportunity to present my research and learn about state-of-the-art technologies from other anisotropy experts. It was also interesting to hear from local geoscientists about the status and problems in gas/oil exploration and production in Western Australia.

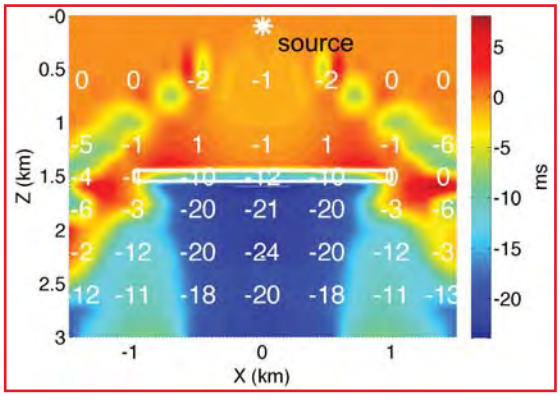
The next IWSA meeting will be held in Bahrain in February 2012.

Coupled Geomechanical and Seismic Modeling of Compaction-Induced Traveltime Shifts for Multicomponent Data

~ Steve Smith, PhD Candidate and Ilya Tsvankin, Advisor, Center for Wave Phenomena (CWP)

Time-lapse seismic methods have proven successful in evaluating changes in petroleum reservoirs caused by production. In particular, production-related reservoir compaction can produce dramatic changes (such as surface subsidence) in the overburden. Accurate modeling of compaction-related time shifts requires combining geomechanics with full-waveform simulation of seismic data. We study the influence of compaction-induced stress and strain around a reservoir on compressional (P), mode-converted (PS), and shear (S) waves. Geomechanical reservoir models are used to generate stress-related stiffness coefficients, which serve as input to 2D anisotropic finite-difference modeling. Reflectors are placed at multiple depths to evaluate time-lapse anomalies for different source locations and a wide range of reservoir pressures. The baseline and monitor shot records are processed by windowed cross-correlation analysis to compute "visualization surfaces" of arrival time shifts with respect to the baseline survey. Geomechanical modeling shows that the stress-induced velocity field is anisotropic, and anisotropy is largely responsible for the offset dependence of P-wave time shifts. Although for PS- and S-waves the contribution of stress-induced anisotropy is smaller, their time shifts are still determined by the entire triaxial stress field (often only vertical strain has been studied). The developed methodology not only helps understand the behavior of traveltime shifts for multicomponent data, but can be used in the inversion for the stress fields of multi-compartment reservoirs. Rock-physics models with complexity beyond the regionally dependent, empirically determined P-wave parameters can be incorporated to explain compaction and time shift effects. Current and future work includes systematic studies of signatures for heterogeneous reservoirs at multiple depths and depressurizations.





Seismic Workshop in Czech Republic

~ Ilya Tsvankin, Professor, Center for Wave Phenomena

In June 2010, Professor Ilya Tsvankin and Professor Emeritus Norm Bleistein attended the SWLIM VII workshop in Teplá in western Czech Republic, which was organized by Ivan Pšenčik, Peter Bulant and their staff from the Geophysical Institute in Prague.

The SWLIM meetings have occurred at five-year intervals. This time, there were 46 presentations on theory of wave propagation, seismic imaging and amplitude analysis. The talks ran consecutively in one meeting room so that everyone had a chance to hear the wide spectrum of presentations. The participants were primarily from Europe with one speaker from Japan and others from the USA, Brazil, Egypt and Canada. Industry, academia, and government laboratories were all well represented. Meeting details can be found at http://seis.karlov.mff.cuni.cz/swlim/

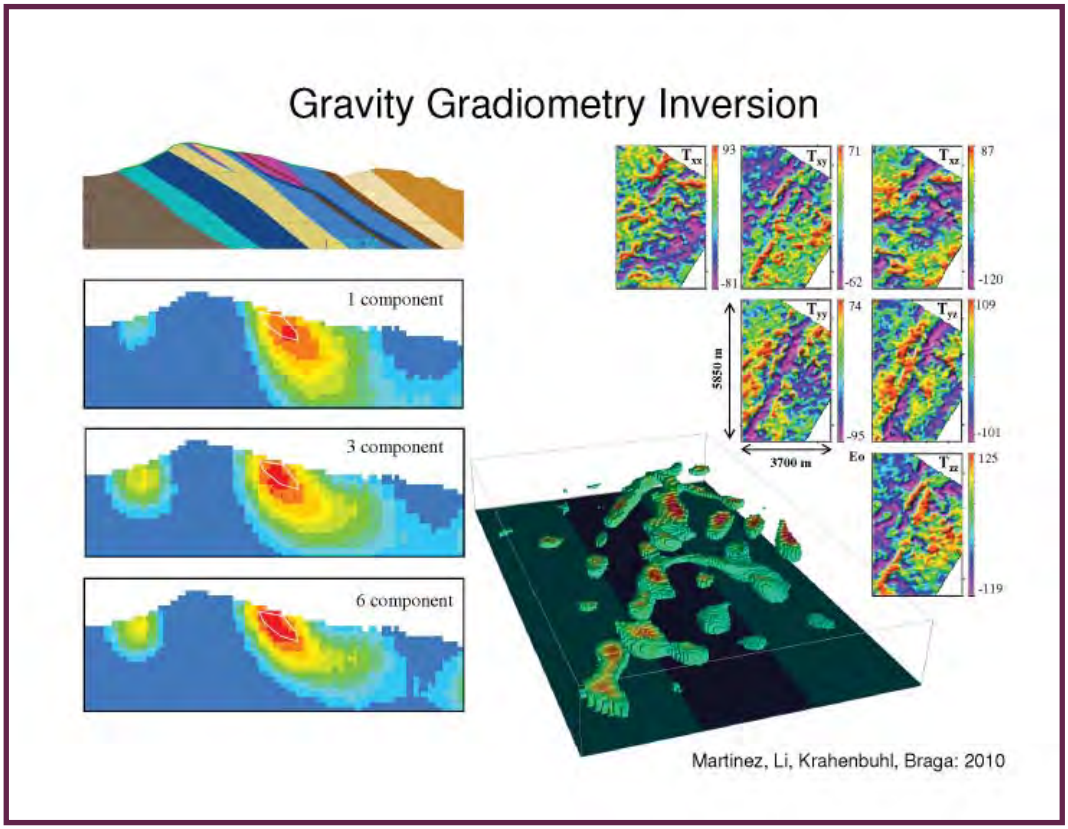
It was a great time to renew old friendships, make new friends, and share our science with the other participants. Because we were in this lovely isolated environment, the evenings were spent in informal group discussions, including postmortems on that day's presentations. This was a wonderful learning and bonding experience!

Gravity Gradiometry

~ **Yaoguo Li, Associate Professor,**

Center for Gravity, Electrical and Magnetic Studies (CGEM)

Gravity gradiometry is among the oldest exploration geophysical methods and played an important role in the early discoveries of oil fields in the United States. Despite a long hiatus of about 60 years, the method has had a dramatic comeback since the 1990s because of the availability of modern gravity gradiometers. Gravity gradiometers measure the spatial gradients of the earth's gravitational acceleration using paired accelerometers offset by a distance. The gravity gradiometry survey has evolved from its earlier marine acquisition to the much wider airborne acquisition at the present. It is poised to become the next revolution in airborne geophysics. There have been interesting and significant advancements in the application of gravity gradiometry, data processing techniques, and quantitative interpretation methods over the last decade. The Center for Gravity, Electrical, and Magnetic Studies (CGEM) has been an important part of the community that is developing the advanced processing and interpretation algorithms for both mineral and petroleum exploration. Our initial effort began with several research projects on the processing and inversion of marine gravity gradiometry data following the formation of the Gravity and Magnetics Research Consortium. Within one year, we developed a wavelet transform-based and an equivalent source-based de-noising algorithm for estimating and removing the high-frequency noise in the marine data. Meanwhile, we applied the unique expertise of our group in generalized potential-field inversion and produced the first full 3D inversion algorithm for recovering the 3D density distribution from multi-component gravity gradiometry data. Next, we turned our attention to practical details and focused on data from airborne platforms. First among these was the effect of low-pass filtering inherent in the acquisition system designed to remove noise from aircraft dynamics. In a collaborative project with Geoscience Australia, we investigated the adverse effects of such filtering on geophysical interpretation and developed an effective means to ameliorate the effect through consistent processing and inversion. We also investigated the obvious but often over-looked issue of the required resolution in digital elevation model used in the terrain correction. We established a clear understanding and practical guidelines concerning basic terrain requirements, which is somewhere between the high-resolution LiDAR data and the commonly available SRTM data from NASA.



This image shows results of 3D inversion of gravity gradient data (right) over an iron ore target in the Quadrilátero Ferrífero, Minas Gerais, Brazil. The known iron formation, seen in the geologic cross section on the top left, contains ore bodies that have a distinctly high density contrast which produces well defined anomalies in airborne gravity gradient data. The three cross sections on the left show slices through three different models corresponding to the top geologic section. A single component (vertical gradient) is sufficient to produce geologically reasonable and interpretable models like the one shown in the middle of the image. Including two horizontal components with the vertical gradient increases the quality of the resulting model, while six components significantly improves the recovered density model by delineating ore geometry and dip.

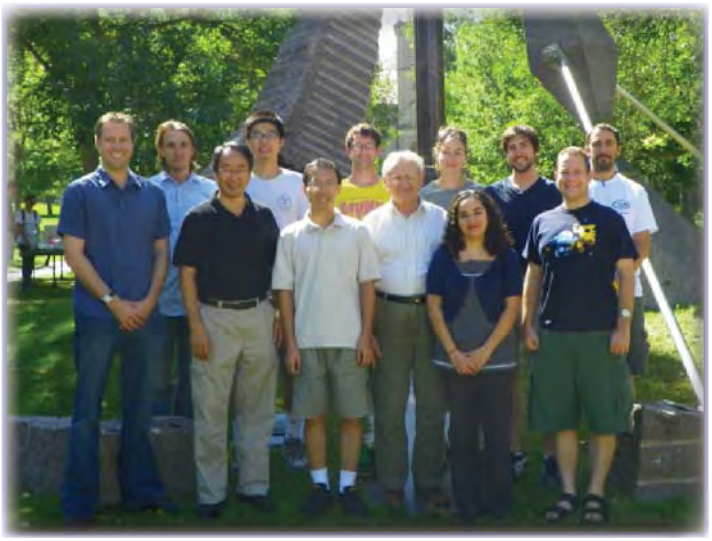
During this period, we also took an interesting and fruitful detour to investigate the use of gravity gradiometry in the non-intrusive inspection of cargo containers. This is a collaborative effort with the University of British Columbia and our research produced a method for rapidly imaging cargo containers to detect high-density anomalies associated with hidden fissile materials. The work

has attracted attention in the port security community. The development of prototype systems based on our proposed method and utilizing the next generation gravity gradiometers is being considered.

More recently, there have been two important developments within CGEM. The first is rapid calculation of the terrain correction, which is an absolute pre-requisite to any quantitative interpretation in exploration problems. We have leveraged the work used widely in image and video processing to increase the speed of terrain correction by 300 times or more without sacrificing accuracy. We use an adaptive quadtree mesh to discretize our digital elevation model, keeping small terrain cells where necessary and allowing large cells where possible. The cell sizes are calculated not only as a function of distance, but also as a function of terrain roughness, which is a huge improvement on the original idea of the Hammer Zone. With this method we can allow coarse discretization in areas of little terrain relief, regardless of the distance from the observation point. For this work, Andy Kass and Kris Davis received the Laric Hawkins Award for the most innovative geophysical research at the 21st ASEG-PESA Conference in Sydney, Australia.

The second development is the successful application of the entire suite of processing and inversion algorithms in the interpretation of airborne gravity gradiometry data from iron ore exploration in the Quadrilátero Ferrífero, Minas Gerais, Brazil. The targeted iron formation contains ore bodies that have a distinctly high density contrast that produces well defined anomalies in airborne gravity gradient data. Three density contrast models were obtained by utilizing different combinations of gravity gradient components. The commonly discussed vertical gradient of the vertical gravity anomaly is sufficient to produce geologically reasonable and interpretable results. Including more components, especially horizontal gradients, leads to much better inversion quality in terms of ore geometry, dip, and distribution of high density contrast. Furthermore, an understanding of the procedure involved in inverting data for a 3D density distribution has been developed. The procedure includes a comprehension of gravity gradient processing steps, terrain correction, noise characterization, mesh design, inversion parameters, and quality of interpretation. For this work, Cericia Martinez received the informal award of Best Student Paper from the SEG Mining and Geothermal Committee at the 80th SEG Annual Meeting in Denver, CO.

Through the persistent effort by students and faculty members in CGEM, we have become one of the leading research groups in the processing and interpretation of gravity gradiometry data. Many active projects are ongoing and new students interested in this field are joining our group. We are looking forward to continuing our contribution to this growing and exciting new field.



Congratulations to the CGEM team on their award-winning year!

SEG 2010 Mining and Geothermal Committee's Best Student Paper Award: Cericia Martinez (presenter), Yaoguo Li, Richard Krahenbuhl, and Marco Braga for their paper on 3D Inversion of gravity gradiometry for iron ore exploration in Brazil.

ASEG 2010 Laric Hawkins Award: Andy Kass, Kris Davis and Yaoguo Li: Rapid gravity and gravity gradiometry terrain corrections via an adaptive quadtree mesh discretization.

- The Laric Hawkins Award is awarded for 'The most innovative use of a geophysical technique' for a paper presented at the ASEG Conference.

SEG 2010 IQ Best Earth Paper Award, Finalist (winner not yet decided): Richard Krahenbuhl, Yaoguo Li, and Tom Davis: 4D gravity monitoring of fluid movement at Delhi Field, LA. A feasibility study with seismic and well data.

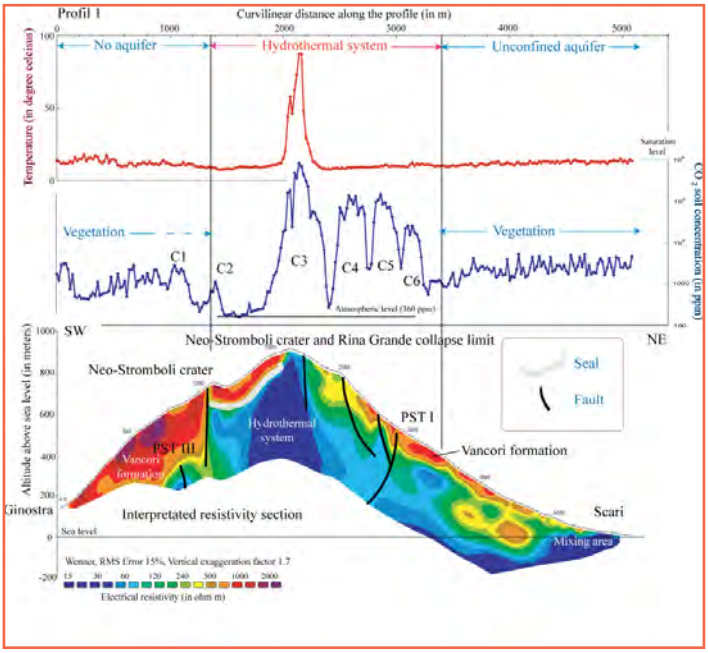
- The IQ Earth Award is designed to acknowledge those who are "creating a fundamental change in visualizing and interpreting subsurface structure, rock and fluid properties; driven by renewed focus on multidisciplinary integration and the new quantitative earth model paradigm; applied by the next generation subsurface scientist."

IMAGING THE FORGE OF VULCAN IN ITALY

~ ANDRE REVIL, ASSOCIATE PROFESSOR

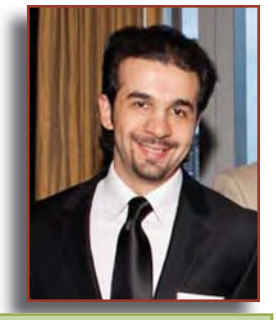
Stromboli, here we are. The mythical island of the Mediterranean sea where Odysseus fought the Cyclops, the creature of Poseidon. The mythic island of the god of Winds, Eolus. We are here to see the unseen, thanks to geophysics. Stromboli is a stratovolcano corresponding to the northernmost island of the Aeolian volcanic arc north of Sicily in Italy. It rises from a depth of 2000 m below sea level to an elevation of 924 meters above sea level.

Its existence is related to the subduction of the African plate under the Eurasian plate and it has been characterized by persistent activity for the 1000 years. It is also a very dangerous volcano because of the occurrence of paroxysms and the possibility of flank collapses that have the potential to generate huge tsunamis on the Western part of the Mediterranean Sea. We are seventeen modern heros (including 12 students from various countries) here to image for the first time the beast. To reach this goal, we have developed the longest resistivity cable in the world: 2.5 kilometers made of 16 segments of 160 m, 64 electrodes with a spacing of 40 m between the take-outs. This tool matches our ambitions. Two weeks of hard work and we have the first tomograms of the structure of Stromboli. We also took some time enjoying the Strombolian activity at the top of the volcano. We plan to come back at the end of 2011 to complete the resistivity survey and to obtain magnetic and gravity measurements to enable a joint 3D inversion of all the geophysical data.



Top right photo: The acquisition area with the ABEM SAS 4000 resistivimeter and Andre Revil (left) and Anthony Finizola (right). Left photo: Carrying the 16 reels along the flank of the volcano is a hard job. Figure: Soil temperature, CO2 concentration and electrical resistivity tomogram along one of the two profiles investigated during this mission. Bottom right photo: Activity!

Congratulations to Ali Araji, GP 2011 MS graduate, winner, Fall 2010 AGU Meeting, Near Surface Focus Group, Outstanding Student Paper Award: "A Numerical Investigation of Cross-Hole Seismoelectric Conversion" co-authored by A. Revil, B.J. Minsley and A. Jardani



Detecting Leakage in Embankment Dams

Scott Ikard, M.E., E.I., Ph.D. Candidate, SmartGeo Fellow

Considering the 85,000 dams (with a mean age of 51 years) and the estimated 100,000 levee-miles contained within U.S. borders, there is an emerging demand for time-lapse geophysical monitoring applications in the water resources industry. With respect to embankment dams and levees time-lapse geophysical monitoring is an evolving tool, and is useful primarily for detecting leakage and internal erosion in these structures to ensure their continuous safety. The self-potential method is particularly well-suited for time-lapse monitoring of earthen dams. When combined with time-lapse geotechnical information such as pore water pressures, seepage rates and water levels in piezometers and observation wells, and additional supplementary geophysical data, this method can yield a rich and accurate dataset to be used for real-time interrogation of these structures.

To help advance the state of practice of time-lapse monitoring applications, I have performed a laboratory experiment designed to simulate leakage in a porous material. The experiment consisted of monitoring the time-evolution of self-potential at the surface in a sand tank while an injected salt slug migrated through a simulated preferential flow path. I conducted this experiment collaboratively with SmartGeo (an NSF-sponsored program on intelligent geosystems) researchers and members of Andre Revil's Hydrogeophysics research group, and we have recently submitted a resulting manuscript to Water Resources Research.

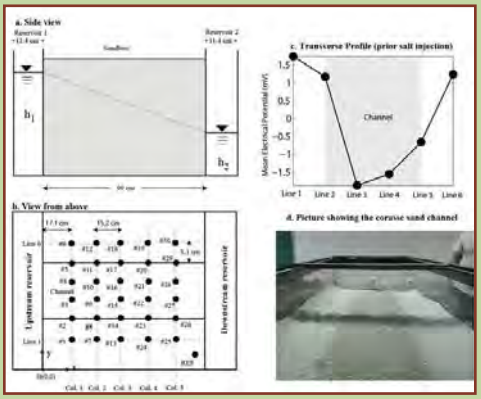
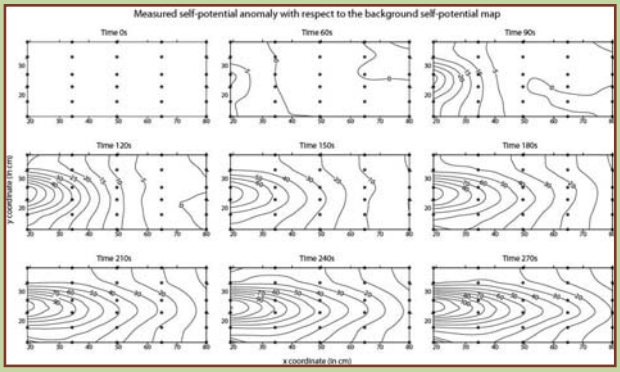


Figure 1 (right) shows a photo of the preferential flow path in the sand tank (fig 1D), and the experimental layout in cross-sectional (fig 1a) and plan (fig 1b) views. Also shown in fig 1c is the transverse mean self-potential profile measured across the channel prior to the injection of the salt slug. As expected, this profile shows the signature behavior of a self-potential anomaly over a preferential flow channel.

Figure 2 (below) shows the self-potential response (after removing the background trend) measured at the surface due to the salt slug migration through the preferential flow channel. Time t = 0 seconds represents the instant the salt slug was injected, and time-lapse surface maps are shown for 270 seconds following the slug injection. These maps show the evolution of the measured anomaly due to the salt slug migration through the preferential flow path with time, and clearly illuminate the channel. By tracking the position of an equipotential within tank through time we estimated a flow velocity through the channel of 0.0045 ± 0.0002 m s-1. This very closely approximates the flow velocity of 0.0059 m s-1 that we observed with a green food dye tracer in the tank. Numerical modeling produced surface contour maps with equipotentials on the same order of magnitude as those observed in the experimental data, and yielded a flow velocity of 6.9 x 10-3 m s-1 through the channel. Velocity information is useful for quantifying the channel permeability. I will apply this method at a small leaking embankment dam outside of Vail, CO in the summer of 2011 to test its effectiveness in a field setting.

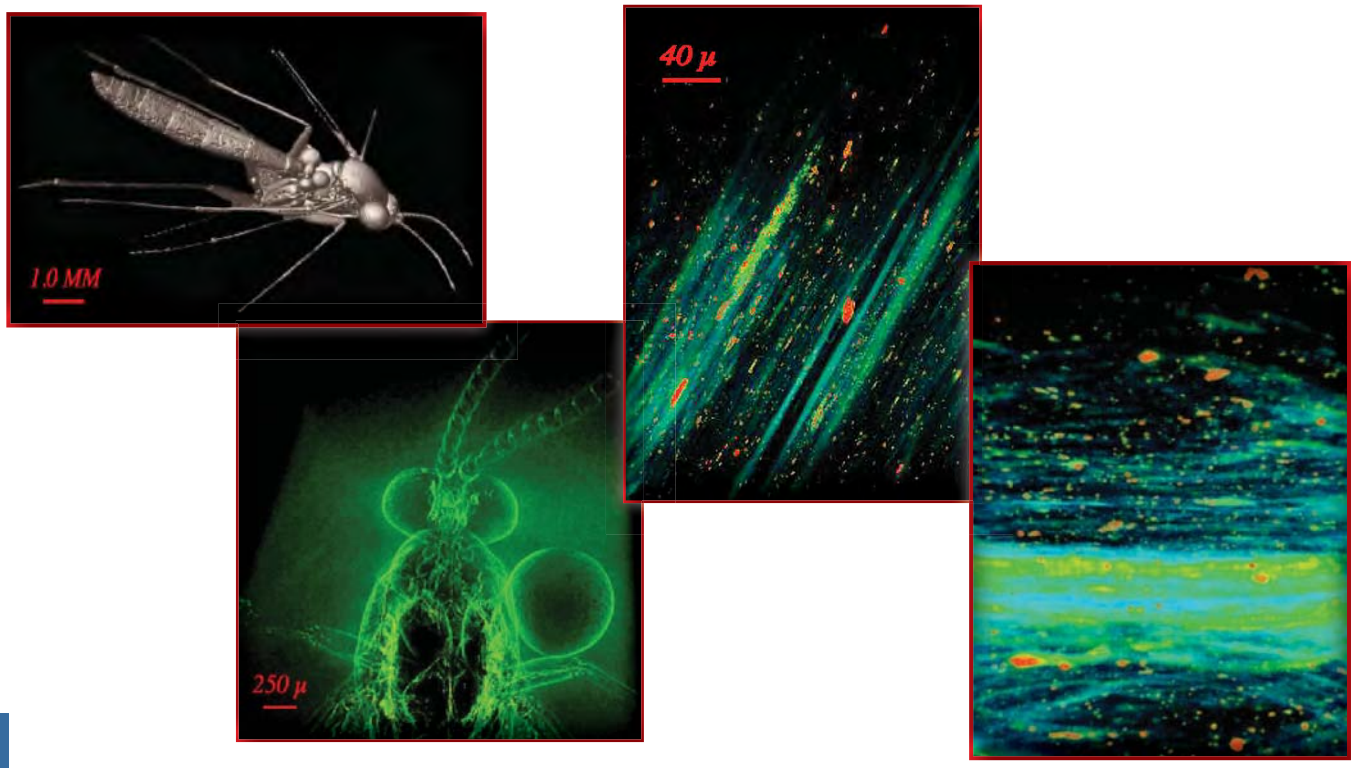


Seeing the Unseen - With X-Rays

Juliusz Radziszewski, Research Faculty, Center for Rock Abuse

When it comes to inspecting interiors of opaque objects like rocks, ceramic or metal parts, living organisms, etc. only a handful of methods are available. Computed Tomographic (CT) imaging is a method of choice if non-invasive or non-destructive treatment is required. Both nuclear magnetic resonance (NMR) and X-Ray CAT scans have become standard methods of medical diagnostics. They provide digital information on their 3-dimensional arrangements (cellular morphology), chemical or density distribution and other properties of samples. The 3-D tomographies are derived from a large number of sequential 2-D photographs obtained during the stepwise rotation of the sample. Our micro X-Ray CT machine provides micrometer precision and serves mainly the needs of geo-sciences (geophysics and geology) but also other researchers on the CSM campus: petroleum and chemical engineers and fuel cell investigators.

Below are examples of research currently in progress at the CSM Micro X-Ray Computed Tomography (MXCT) facility. More information is available at: http://mxct.mines.edu.



Bugs: Fossilized in amber, the mosquito's CT shows fine details of its external shape or internal organs and allows paleontologists and entomologists to study minute evolutionary changes when compared to contemporary specimen. This mosquito is 26 million years old.

Rocks: Oil shales are an enormous potential energy resource in western Colorado. The CT of oil shale shows layering of base carbonate rock, pyrite inclusions, kerogen distribution and overall structure of fractures and pores. Detailed analysis allows for determination of rock porosity, organic content and mechanical properties, the information required for optimizing oil and gas extraction. The images obtained are used to construct micro-mechanical models that describe the strength of characteristics of the rock.

Undergraduate Research in the Center for Rock Abuse

Last semester I began working for Dr. Michael Batzle at the Center for Rock Abuse, as well with Dr. George Radziszewski. This semester I have begun to learn how to use various IDL-based image-processing software packages to help examine rock core samples. These samples are first examined in the department's Micro-X-Ray Computed Tomography (MXCT) machine which uses X-Rays to gather thousands of images of the sample as it is rotated 360 degrees. The data processing software is then used to construct three-dimensional images of the sample. The packages can be used to acquire information about a wide array of the sample's properties including individual grain dimensions and orientations.

With these data, various rock properties can be determined non-invasively. In addition, the MXCT machine is capable of analyzing very small samples (I was shown images acquired from another similar machine that was examining structures on the order of hundreds of nanometers). Since the image-processing software is fairly new on campus, it will be my job to learn how the various packages work and how best to apply them to the data. Though formidable, it is an exciting challenge that I look forward to meeting this semester.

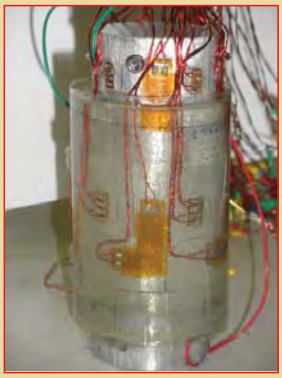
Gordon Osterman, GP Junior

Rockin' in the Bakken

Jesse Havens, GP Graduate Student, Center for Rock Abuse

The Bakken Formation has recently made headlines with an estimated 400+ billion barrels of oil in place with approximately 4-7% of that recoverable through primary production. Perhaps the more staggering figure is the number of fracture stages companies have been placing in horizontal wells (rumored at 20-40). While total production has steadily increased, there has not been sufficient evidence that proves more stages correlate with higher ultimate production. Each company appears to have a different theory about completion strategies and how the hydrofracture stimulations are contained. In the midst of uncertainty lies opportunity…

In the Center for Rock Abuse we have the ability to measure rock samples under realistic in-situ stress conditions. Engineering properties such as Young's modulus and Poisson's ratio that are required for reservoir simulation and hydrofracture models have been shown to change under different stress conditions, frequency ranges, and strain amplitudes. Under the tutelage of Mike Batzle we have one of the few laboratories in the world that can acquire the data necessary to separate these effects. In the Bakken our goal is to produce geomechanical data that the industry can apply to hydrofracture modeling and reservoir simulation to improve production strategies and drilling techniques.



RCP & the Next 25

~ Tom Davis, Professor,
Reservoir Characterization Project

Amazing how 25 years can go by so quickly. One year ago I was writing about preparations for the 25th anniversary of the Reservoir Characterization Project (RCP).. The year flew by and we turned 25, so "What's the big deal?" Well it turned out to be a bigger deal than I imagined. We had the largest number of attendees (135) ever for our 25th Anniversary Meeting held October 14 and 15. We booked out the Fossil Trace Golf Club for the reception and the weather was perfect. The collage of pictures from this event shows that everyone enjoyed the festivities.

Our 25th anniversary not only provided a look back, but more importantly, a look ahead. An amazing line-up of speakers provided the look ahead and, for those of us that had the pleasure to hear these oracles express their viewpoints, it was incredibly enlightening. The talks focused on several themes including integration, geomechanics, multicomponent seismology, time-lapse seismology, microseismic, life of field, etc. A talk entitled "Why RCP matters" generated an enthusiastic response and led to discussion of the need to demonstrate value.

Everyone agreed that technology will continue to be the main driver in the search for energy and that we have a long way to go to develop new technologies for the future as resources are going to be more difficult to find and exploit. Also, it is apparent that technology is of little value unless it is used, and used well, by people. Thus the real focus has to be on people and education. For that reason Mines and RCP are well positioned for the next 25 years.

Congratulations to Cucha Lopez, GP 2010 MS graduate, Reservoir Characterization Project, Winner, SEG Award of Merit - Best Student Oral Paper, 2009 Annual Meeting: "Sandstone Petrofacies Prediction to Characterize Permeability for Postle Field, Oklahoma, Thomas Davis, co-author (Awarded 2010 SEG Annual Meeting, Denver).

"The Art of Being a Scientist" Travels to Saudi Arabia

Roel Snieder, Professor and Ken Larner, Professor Emeritus

In late January, at the invitation of former CWP students, Professor Tariq Alkhalifah, of King Abdullah University of Science and Technology (KAUST), and Dr. Abdulfattah Dajani, of Saudi Aramco, Roel Snieder and Ken Larner presented their multi-day short-course to young professionals of Aramco in Dhahran, on the east coast of Saudi Arabia, and to graduate students and postdocs of KAUST, on the Red Sea near Jeddah, on the west coast. The topic of the course was "The Art of Being a Scientist". This short covers material to help young researchers develop effective research habits. At both locations, the audience size was large (30 to 45 students), and, throughout, interactions with the bright and enthusiastic students were lively and virtually non-stop. The course was well-received at both places; as exemplified by the following quote from the evaluation held at the end of the course:

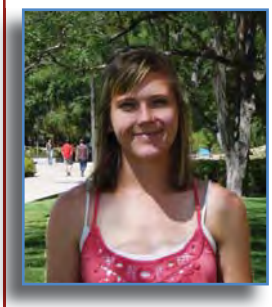
"The presentations were awesome. I am glad to have found this early in my academic career. Now if only my university had required faculty members to come to your talk, that would have been beneficial for them too. Thank you for putting all the things together that otherwise would have taken me years and many unfortunate incidents to figure out."

The course at KAUST was a component of the Winter Enrichment Program (WEP) held between semesters, involving more than 50 internationally recognized scientists. On the day following the end of WEP, Roel and Ken presented talks in the workshop, "Seismics: the present, and where are we headed from here?" with invited geophysicists from the U.S. and Europe.

Words fail in describing the campus, labs, and lightning-speed build-up of both faculty and students at KAUST, the three-year-old research university.

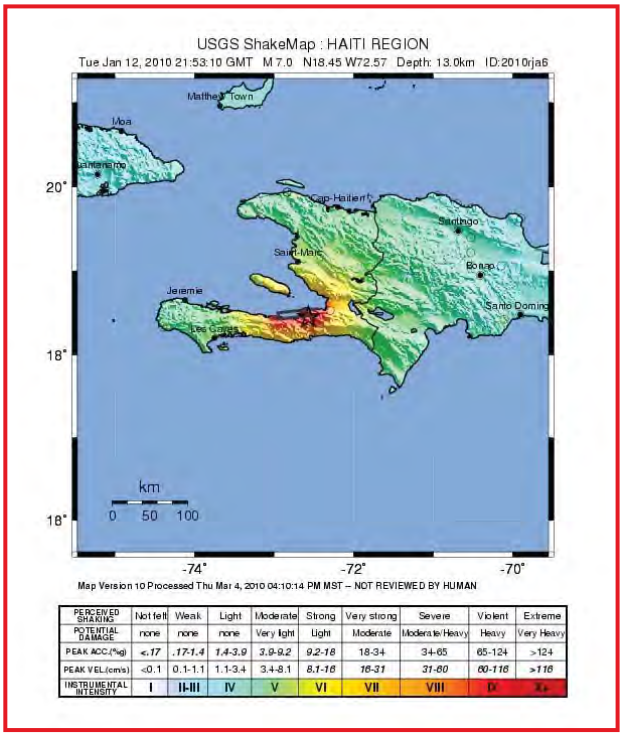
The food and sites both in Dhahran and Jeddah were wonderful, but most special during the trip were the many friends, mostly Mines graduates, we spent time with both at Aramco and KAUST. Space doesn't allow us to name everyone, but we especially appreciate the wonderful hosting by three CWP Ph.D. alums, Tariq Alkhalifah, Abdulfattah Dajani, and Mohammed Alfaraj.

Partnership with the USGS



Leslie Godfrey,
GP Graduate Student

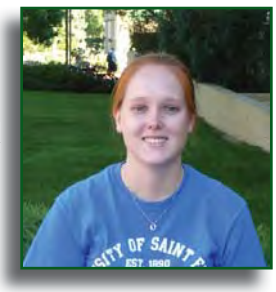
It's early morning. Before the sun has even risen you're awakened by a slight tremble. You think it's nothing, but the shaking gets stronger and you begin hearing glass tinkling and dogs barking. You hide under the doorframe as furniture is overturned and plaster is knocked loose. You've just experienced an earthquake. Scenes like this have become more and more frequent in the past few years. Large earthquakes, such as the one that struck Haiti last year, have wreaked more devastation than ever before, in terms of loss of life and economic loss. In order to help limit the devastation, I've been working since last summer with the USGS's National Earthquake Information Center (NEIC) on a project to determine Vs30 values for the U.S., which will in turn tell us about the ground amplification across the country.



Haiti Shake Map and USGS logo from USGS website

Vs30 is the shear wave velocity that's been averaged over the top 30m of the surface. In general, loose soils have low Vs30 and solid rock has high Vs30 values. Despite the fact that we don't have dense coverage of Vs30 data over the U.S., we do have country-wide topography and geology data. Topography is most helpful, because in general, the steeper the topographic slope, the higher the Vs30 is. For a few cases such as table mesas, which are solid rock with very small slopes, the geology map would take an average of other Vs30 measurements in that same geologic unit and apply that as the Vs30 at an unknown location in that unit. Thus, by using the cokriging geostatistical method, we can weight Vs30, geology, and topographic slope so that with all 3 datasets we can come up with the most accurate Vs30 map of the U.S. to date. Unfortunately, since flat areas where cities are built are generally comprised of loose soils, the soil amplification of populous areas is likely to be quite large when an earthquake strikes. That's why Vs30 is so important, since the velocities can be put into tools such as ShakeMap and PAGER at the USGS, which allow for faster emergency response should a large earthquake occur.

Why Geophysics? - USGS



When I was in elementary school, around second or third grade, I joined my best friend's Girl Scout troop. During my time in that troop, we came up here to Golden to the Colorado School of Mines twice for their Girl Scout Badge Day that they hold here every February. This day is set up for the troops in grades 4th through 6th to learn about math, science, and engineering by earning badges associated with each of those subjects. We would participate in many different activities including building bridges out of tooth picks and gummies, making asphalt cookies out of melted chocolate and oatmeal, and touring the campus. These activities helped us to learn a little about what

it is like to be an engineer, and after that I knew where I was going to go to college, The Colorado School of Mines.

High school is where I found out what I wanted to study here at Mines. I took a geology class for a semester during my junior year, which I enjoyed so much, it was my favorite class in all of my four years. I took what I learned in that class and paired it with my love for earthquakes and volcanoes. So I decided to major in Geophysics, which takes math, science, and geology (all subjects that I love) and involves them with my fascination with earthquakes and volcanoes.

Then I arrived here at Mines freshmen year and learned that the USGS had an office right here on campus, and a part of that office was the National Earthquake Information Center. I have taken two tours through the Earthquake Center and thought that it was fascinating to learn a little more about earthquakes themselves and what they do there at the center. Someday I hope to get a job working there, so I can take what I have learned from my professors and the courses I taken here at Mines and use them in a job that I would love and enjoy going to everyday.

~ Lindsay Patterson, GP Sophomore

15 Weeks, 30 States and the Advanced National Seismic System

I began working for the USGS, in the Earthquake Hazards Program, the summer following my freshmen year in college. I was hired as an engineering aide on the Advanced National Seismic System (ANSS) backbone task, which installs/maintains a 100+ station network throughout 49 states. The ANSS is a subset of the Global Seismic Network (GSN), and the two often coordinate on maintenance efforts and monitoring. Our office is located on the Colorado School of Mines campus, but both the ANSS and GSN are headquartered at the Albuquerque Seismological Laboratory (ASL) on Kirtland Air Force Base in Albuquerque, New Mexico, directed by Lind Gee.

When I began my work at the USGS, I was part of an eight person team split between our two offices in Golden CO and Albuquerque NM. At present, there are six of us: 3 Electronics Technicians, 1 Research Geophysicist, 1 Supervisory Research Geophysicist, and 1 Engineering Technician (my job title after promotion). The summer I began, we were in the midst of a satellite vendor upgrade, which required visits to every individual station to swap out the satellite dish and modem to the new company's equipment, among other maintenance issues. This was completed late in the 2009 calendar year, and we then began an equipment upgrade. This upgrade required us to replace seismometers and data loggers at sites with older equipment, with 3-component Streckeisen STS-2 broadband seismometers, and Quanterra Q330 data loggers. This upgrade was completed late into the 2010 calendar year, and the only work left to do was sporadic maintenance trips whenever they occurred.

A particular highlight of the job for me is the large amount of travel time. During the summer, I spend almost 15 weeks in the field working an average of 80-hour weeks. I have gotten to travel to nearly 30 states, and work in some amazing places. My favorite trip was a 3-week installation/maintenance trip to Jackson Hole, WY to work on the Intermountain West Network. We stayed in a condo in downtown Jackson Hole and travelled every day to work on the surrounding stations in Grand Teton National Park, the National Elk Refuge, and parts of Idaho. Being paid to backpack through the Tetons to install solar sites is one of the best experiences I can imagine. There have been many more trips like this to Northern California, Washington, Maine, and even home to Michigan. The travel aspect is what I enjoy the most. Also, the opportunity to work and attend meetings with the leading folks in the field is quite extraordinary. Working with people from IRIS, Passcal, the USArray, Project IDA-Scripps, Lamont-Doherty, and many people within the USGS itself has proven to be an unbelievable experience.

~ Travis Pitcher, GP Junior

Photo: Installing radio communications to a repeater site which then sends seismic data back to the NEIC in Golden, CO via satellite.

Women in Geophysics

Planting SEEDs

Cericia Martinez, GP Graduate Student

In August of 2010, I had the exciting opportunity to introduce a group of middle school students in 6th-8th grades to the world of Geophysics. The Summer Engineering Education & Development (SEED) Program was a joint effort between the campus Minority Engineering Program (MEP) and Skinner Middle School from the Denver Public School District. The SEED program is meant to introduce at-risk youth to science and engineering in the hopes of encouraging statistically underrepresented students to pursue a college education.

Through the week long program, students participated in geophysics and civil engineering classes with field trips to Dinosaur Ridge and the Geology Museum. Activities were focused on improving critical thinking skills, team work, and time management. In the civil engineering section, classes were focused on providing the students with the skills necessary to build a balsa wood bridge for a group competition at the end of the week. In the geophysics class, students learned about what the area of study is and what some of the tools and applications are. Topics meant to provide a broad overview ranged from discussion of Earth's gravity field to the exploration of Mars's surface. The students put on their geophysicist hats and attempted to discern what everyday household items were in a 'black box' or bag using only the tools readily available to them: their ears, nose, and hands. At the end of the week, with many grunts and shouts of 'Wow, that's heavy!' students were given the chance to see and pick up some of the equipment used by the department.

By the end of the week, students had barely brushed the surface of the many science and engineering topics. In a feedback discussion with the students, it was obvious they were excited about what they learned. It was amazing to see some end the week with a spark of exhilaration in hearing about a possible future for them that they may never have thought possible before. Hopefully their experience here at Mines has planted a seed and inspired them to explore something new; whether it is science or engineering related, or simply the aspiration of higher education.

Saudi Women Enjoy Opportunities in Geophysics

In 1938, the Kingdom of Saudi Arabia witnessed its first oil discovery at the 7th drill site located in the city of Dammam, otherwise known as Dammam Number 7. The development of this well, at a production rate of 1,500 barrels per day, quickly established Saudi's main economic foundation. Eighty years later, Saudi Arabia continues as one of the world's largest and most important oil producers. The oil and gas industry in Saudi Arabia is today operated by one of the world's largest oil producing companies, Saudi Aramco. This company oversees one of the largest reserves of crude oil, acting as its exporter in the country. This company further operates extensive networks for oil and gas refinery and distribution.

Saudi Aramco has not only influenced the country's industrial sector but has also shown significant interest in the educational sector. For a long time, Saudi Aramco has sponsored foreign internships for undergrad, master and PhD male students in all engineering fields. Recently, Saudi Aramco has begun sponsoring Saudi female students as well, marking a significant turning point in Saudi history, especially since Saudi females were never allowed to participate in engineering before this new opportunity. Among its educational contributions, Saudi Aramco provides great opportunities for petroleum, geology and geophysics internships ensuring a great educational and cultural experience.

~ Qamar Bu Khamseen, GP Senior

"It is either the medical school or nothing. And if you are lucky, maybe a scholarship will come along". This has always been the case, mostly for females in my country, Saudi Arabia. And despite that there have been some more opportunities in the past couple of years; I had to choose between medicine and applying for a scholarship in the year of my graduation from high school. My scholarship provides students a wide list of majors to choose from. I knew nothing about what is best for me. I started to read about science and

Mines Women Challenge Mining Superstition/Rescuers Train to Save Lives of Miners

Georgiana Zelenak, GP Sophomore

CSMMRTSilver, top row: Kelly Puzak, Gracie Bernard, Georgie Zelenak, Hannah Brinkmann, Dianna Ponikvar, Christine Geier; bottom row: Chelsea Pomeroy, Erin Keogh, Nicole Henderson

Traditionally mining has been the work of men. Superstition abounds underground, and right up there with the legend of Tommy Knockers rescuing miners in danger there is the belief that a woman underground brings bad luck. Even today men say that they would crawl out of the mine before they would allow a woman to rescue them. The Colorado School of Mines Mine Rescue Team Silver (CSMMRT Silver) is out to change this attitude and prove that an all-women rescue team can perform as well as a group of guys.

In February CSMMRT Silver became the first all-women team to compete in an official mine rescue competition. During the Mine Emergency Response Development exercise in Idaho Springs teams ran incident command and served as backup and primary teams during a simulated mine emergency. First aid, fire fighting, and underground construction skills were tested as teams from Pennsylvania State University and University of British Columbia, as well as the Colorado School of Mines all-male Blue Team and CSMMRT Silver competed. All teams performed well, and Team Silver was proud when we placed second at the end of the competition.

Confined space rescue - Christine Greier

Many probably wonder why a geophysics student is involved in mine rescue. Being on the team has taught me communication skills that could never be learned in the classroom. As the co-captain for my team I am responsible for maintaining communication between the group working underground and the people at the fresh air base on the surface. In a sense I am the lifeline, the one that makes sure a backup team could reach us if we ran into danger. Effective communication is obviously a necessity.

Mines Emergency Respnse Development (MERD): Kelly Puzak, Hannah Brinkmann

Rescue has also taught me how to face my fears head-on. When I joined the team I had an intense fear of confined space. Within the first few training sessions the team was required to go through the underground maze, which is a labyrinth of irrigation tubes and restricted crawl spaces. On my first attempt I couldn't get more than a few feet. Yet, with the support of my team, I was able to make it through the maze on my second attempt. By the time the team attended Fire Academy in mid-November I was able to move through a hundred-foot long irrigation pipe no broader than my shoulders. If I can do that, I honestly believe that I can do anything.

More than anything mine rescue has taught me the importance of teamwork and trust. If we were ever called to help with a real emergency I would literally have to trust my teammates with my life. As a team we would weigh the risks and rewards of a situation and decide on a course of action. Future work in geophysics, although maybe not quite as risky, would need the same sort of teamwork.

I am proud to be a member of the CSM Mine Rescue Team, and would highly encourage anyone from any background to join the group. You'll never face a harder challenge, and yet you will also never find a more rewarding activity.

Left Fire Academy, top row: Hannah Brinkmann, Georgie Zelenak, Gracie Bernard,; bottom row: Christine Greier, Maura Sullivan

engineering majors. And I ended up choosing geophysics.

Math and physics have been a passion for me. I was applying to Colorado School of Mines so I chose geophysics knowing that it is one of strongest departments in the school. I did a little research about the program and the required courses and I liked it. Not to mention that my scholarship's sponsor is a big oil company in my country, so they take a good care of geophysicists and engineers. Although it is only my third semester here, I love geophysics and all the courses that I am taking.. ***~ Hala Qatari, GP Sophomore***

Earth Works

Meghan Helper, GP Junior

At the Colorado School of Mines there are a plethora of extracurricular opportunities and clubs. Clubs for athletes: club hockey and cycling club. Groups dedicated to the right side of the brain: Anonymous Right Brain Society and Mines Little Theater. Societies rooted in academics and service: Blue Key and Tau Beta Pi. I personally have the privilege and responsible of being the president of an organization: Earth Works.

Kendra Johnson, Vice President and Meghan Helper, President at the Four Mile Canyon erosion mitigation.

Earth Works strives to promote green education and life styles. Throughout the year, Earth Works participates in local clean-ups at Red Rock, Clear Creak, and the bus stops along Jackson Street and South Golden Road. We love to get dirty, have fun, and preserve the natural environment. After the Four Mile Canyon Fire, Earth Works went to the affected area to learn and lend a hand in erosion mitigation. The week of Earth Day is the most exciting time for Earth Works. This year, Earth Works scheduled lectures on water conservation and leave-no-trace camping, tree planting, clean-ups and a huge bash in Stratton Commons with informational exhibitors, bands, beer and food.

Some of the Earth Work's members at the Four Mile Fire cleanup.

Earth Works works for its members. The projects we work on and the direction the group takes are entirely up to the members. We accept all potential members and are always looking for people who love to work outside, improve our planet and goof off.

Why Geophysics? - Discovery

Deciding a major is a tough thing to do. At least it was for me. I came to Mines wanting to study Mechanical Engineering. That thought quickly left my head after first semester of freshman year. Then I was undecided until fall semester of my sophomore year when I decided to try Civil Engineering. However, it was a fallback. I didn't know what else to do! I was frustrated because I was craving excitement, but instead I felt like I was settling. I would toss and turn at night trying to figure out what it is I actually wanted to do. This is surprisingly a fairly difficult decision when one is majoring in engineering. Let's say you wanted to be a pilot, so you were going to school for aviation. You would know what you were getting into, what you would be doing when you were done with school. You would be flying airplanes! I was jealous of those people who had a passion for something and were going after it. With engineering, you couldn't possibly know what you would be doing or where because it's so broad. Engineers can work anywhere, on anything, for anybody! I just knew that I wanted an adventure more than anything.

On a random thought, I started looking into geophysics. I remembered learning about it at the major/minor fair the last semester but I had so much information in my head that I didn't really stop and think about it. As I researched it, I started finding some pretty cool stuff! Earthquakes, volcanoes, natural hazards…..space? Exploration? Whoa! All these words caught my interest. I still don't know what I'm going to be doing or what I'm going to be working on, but the beauty of geophysics for me is that I'm ok with that! The words "discovery" and "exploration" had intrigued me and I was ready to jump into it. So now I'm taking some classes specific to geophysics and learning even more about all the possibilities and what I would like to do. I could specialize in planetary science? Hmmmmmmm……..

The thoughts are still there: what should I do? Where am I going to be after I graduate? But, instead of worry and frustration, there is excitement and motivation. And let me tell you, it feels great. ***~ Dani Hunt, GP Sophomore***

American Conservation Corps

Chelsea Newgord, GP Junior

Last summer I worked for American Conservation Corps (ACC), which is a subset of the Rocky Mountain Nature Association – a nonprofit organization supporting Rocky Mountain National Park. About twenty-five college students are hired each summer and then divided into crews of six people. My crew worked mostly in the Red Feather Lakes area where we made a new trail, maintained older ones, put in log checks, cut trees, and trimmed branches daily as we hiked through the Roosevelt National Forest. Our crew also spent a week backpacking and working in the Rawah Wilderness with another ACC crew. At the end of the summer, we spent two weeks in the White River National Forest near Aspen working on the Maroon Bells trail and Conundrum Hot Springs Trail. My favorite part was travelling around the most beautiful parts of Colorado to hike and work every day and laughing and having a lot of fun with the people on my crew. Though it was hard (and sometimes tedious) work, I learned a lot this summer about the outdoors, working and living with the same people, and enjoying life!

Another day "in the office" – Conundrum Hot Springs Trail

Backpacking to our campsite in Rawah Wilderness

Clinton Global Initiative University

Bethany Behrens, GP Junior

EPICS II is just a class, right?

You sign up, pick a project, get a team, and write some reports. It seems that EPICS projects rarely get finished in a semester. This makes sense because of the magnitude of some of the projects. Since EPICS is only a class, students work on their project for the allotted time then move on. This is not so for one EPICS team.

This EPICS team chose to work on an essential oils distillery for women in Zambia so the women could make a living for themselves. Right at the beginning of the semester, a unique opportunity was presented to them: Clinton Global Initiative University. CGI U is a organization started by President Bill Clinton to bring young people with ideas together to help those in need. The team applied, and they were selected to attend CGI U at the University of Miami. At the conference in Miami, they met people from all over the world including Egypt and Haiti. Many people of influence were in attendance as well - President Clinton and a member of the Kenyan Parliament to name two. Ideas were shared and friends were made. That was in spring of 2010.

The team decided to continue working on the oil distillery throughout the fall semester of 2010. They completed the prototype and did some test runs with lavender. The prototype has some improvements to be made, and the team decided to work on it in the spring semester of 2011, seeing as they all have more time this semester. Again they applied to CGI U, and again they were accepted. This year the conference is in San Diego. All expenses paid for a trip to California without missing a day of school. Can't beat that.

Why Geophysics? - Questions

I study Geophysics because I like questions. I like questions better than I like answers. Questions open my mind, they show me different ways to see the world, and they teach me about the preconceptions that help or hinder new understandings. I carried and lived existential questions most of my life… to which I found no answers. Except that they showed me all that I did not know… so much so, that amazement to the spectacle of life resurged in me as if I were a newborn. And this newly energized curiosity found its focus on the planet from which I came.

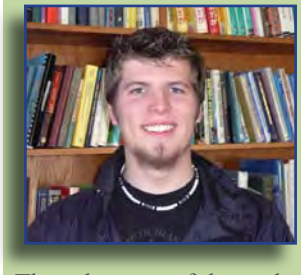
But Earth is not just a ball hanging out in the sky, and as I learned about it, I became fascinated with its geological history, with the forces and processes that shape it, and with the interrelationships within the solar system. I also became curious about the scientific model, about learning to use symbols and math to see in a simplified manner the complexity of the universe. And I came to admire the humbleness of this approach.

Today I study geophysics because it puts me in the center of this amazement about the planet, because it helps me to expand my questions and my understanding, and because it helps me to live my life as if I could feel the tectonic plates moving and the whole earth rotating under my feet. What will I do with it? I do not know. I am learning, which is a lot to do, and, after all, time will tell. But for now, because I believe that we only live once, this is my way of making the most of my life on Earth.

~ Arantxa Gallasstegui, GP Sophomore

Geophysics Internships for Underclassmen: It Can Be Done

Stephen Cuttler, GP Junior



Though many of the undergraduates in the geophysics major know that there will likely be many jobs available to us after graduation, one of the major frustrations of the major is the apparent lack of companies willing to give undergraduates internships. This is especially true for the freshman and sophomores desperately trying to get a start in the industry who are turned away out of hand because of their class. However, there are internships out there, and underclassmen can get them. You just have to know how to look.

First of all: do your homework. Colorado School of Mines offers an invaluable service through its DiggerNet website. The Diggernet website provides students with a good place to start and maintain a good resume, cover letter, and letters of recommendation as well as making them available to prospective employers. A job agent on DiggerNet will automatically search for internships and job opportunities within parameters you establish and send you a daily email with the results. You can view and apply for those internships on Diggernet, but if the time restriction allows, I recommend a different course. Keep track of what companies are looking for students, as well as their industry and the type of internship they're offering, research the ones you find particularly interesting, then put together a plan for Career Day.

When Career Day comes, the most important thing to remember is to be confident and stick to your plan. Talk to as many companies as you can, even if they do not appear to be interested in you. Appearing confident and knowledgeable about the company, the internship, or the industry often impresses companies more than an impressive resume, and can actually compensate if you are missing things in your resume that they are looking for. Take every opportunity you can to give away a resume, even if they make it clear that they will not give you a job. Though you may not get a job this semester, this shows the company that you are interested and increases your chances of getting hired at a later date. However, the most important thing you can do at career fair is to talk to as many companies as you can. You never know which companies may be interested in you, and the more resumes you hand out means the better chances you have of getting an interview.

If all goes well, a company will contact you about setting up an interview. Take it, no matter how you feel about the company or your chances. Every interview is not only a bid for a job, but also practice for future interviews; learn from the mistakes you make so that when the next one comes around you will avoid those mistakes. When the interview comes, be confident, friendly, and most importantly honest. Play up your strengths (minors, past work, clubs, skills) at every opportunity, but also be honest about your weaknesses and shortcomings. No company expects to hire the perfect candidate, and they like to see that you are aware and have learned from your mistakes.

Finally, don't get discouraged. Not every company will be interested in you, not every resume will lead to an interview, and not every interview will get to a job. However, if you take every opportunity you can, you will find an internship.

CSMAA and Internships

Loralee Wheeler, GP Sophomore

Since I am dead set on getting an internship this summer, I decided to join the CSM Student Alumni Association (CSMAA). They advertised networking as well as help with resumes and mock interviews. After joining, one of the directors of the group, Heidi, told me about the mentoring program that they have. If you signed up for this program, the directors of CSMAA would use your application to match you up with an alum, who would be able to assist in internship/job search, resumes, mock interviews, and more. This was exactly what I was looking for, so I signed up immediately.

The directors of CSMAA matched me with Melanie, a geophysicist working at Encana Oil & Gas in Denver. She had worked everywhere from Houston, TX to Alaska with several different oil companies. She then invited me to visit several companies in Denver and meet the geophysicists there to get an idea of what work as a geophysicist is actually like. Along with this, Melanie is glad to help me build my resume, prepare for interviews, and she constantly invites me to meet other geophysicists. I will keep in contact with her for the rest of my life, giving me a great friend and a great contact.

Softly, a piano's blithe melody marks the beginning of tonight's tanda.

Beauty without flaw, elegance sans force, the delicate whisper of a violin flickers in the air.

Strings of lights accent Mercury's salon, creating the illusion of a crisp winter's eve. Roses adorn every table top, every hairdo. Legs crossed with perfect posture, bailarínas anxiously await their moment to shine.

From across the dance floor, a gentleman dressed in modern, sleek attire catches my eye. He gradually approaches with purpose and poise. While maintaining eye contact, he gently nods and extends a hand as an invitation to dance. I return the gesture.

As we approach each other, a woman's voice, poetry born in Buenos Aires, ignites passion in the hearts of the dancers... "En el mundo habrá un lugar para cada despertar, un jardín de pan y de poesía"…

From the depth of the soul, the stranger from across the room and I join on the dance floor in closed embrace. Contact from waist to chest, my left arm is draped around his neck; our frames become one. My eyes closed, I surrender to my lead's self expression. The collaborative adventure, the game of tango, has begun.

Argentine tango is a passion of mine; it's an expression of mind, body, and soul. It's a form of art; a form of relaxation. It's a game of give and take, of complete awareness, of complete connectedness between partner and self. I was introduced to the dance three years ago at Mines.

Every week, the CSM ballroom club offers lessons in Argentine Tango and other dances such as blues, swing, and waltz. As a treat after the lessons, we treck to the Mercury cafe in Denver on Fridays. On special occasions, there might be a live band, or maybe even performances by professional dancers from Buenos Aires, the birthplace of Argentine Tango. If we get lucky, one of them might even ask us to dance. . .

~ Ashley Fish, Combined BS/MS Student

To join or not to join?

Matthew Fackler, GP Junior

In the fall of 2008 I came to CSM as a freshman. I knew that Mines would provide the best engineering education in the state, but I was about to find that it would do more than mold me into a competent geophysics major. Just in the first week of school, invited by my fellow roommates in Weaver Towers, I visited the fraternities. Later that week, I was given a bid by Sigma Nu and attended their bid dinner. Reluctant to join, I asked several tough questions, but each answer gave me a greater image of Sigma Nu, and I accepted my bid right then.

It seems like a hasty decision, but looking back, I'm extremely appreciative that I made that decision sooner rather than later. Sigma Nu has provided more value to me than any other organization or club I've been a part of at Mines. Coming to Mines, as most students, I had a strong desire to maintain a high GPA. Sigma Nu provides an environment that has allowed me to accomplish this. I often have quick access to people who have taken the class before and are willing to help, as well as others who are currently taking the same class. We even have academic workshops and study sessions on a regular basis.

Fall 2009 – Burying a brother's truck

Fall 2009 – Shaving cream fight with Alpha Phi

In regard to preparation for life after Mines, we have regular sessions on topics such as networking and managing money. I have also had the privilege of holding four officer positions: Recorder, Reporter, Social Chair, and Lt. Commander. This has given me the skills to manage my responsibilities and work in a cooperative manner with fellow members. In regard to entertainment, there is never a day that goes by in which there isn't either an excellent event set up by one of our officers or a random and hilarious conversation. In my time here, I have never made a more important decision than the one to become a member of Sigma Nu. It brings friends, fun, and personal growth which complete my Mines experience.

Spring Convocation

Doctor of Philosophy, Geophysics:

Praj Mazumdar

Master of Science, Geophysics:

Allan Haas

Cucha Lopez

Sony Mohammad

Alana Robinson

Maria Gabriella Melo Silva

Front: Mike, David, Kristen, Cucha, Sarah

Bachelor of Science, Geophysical Engineering:

Brandon Bush
Joseph Cohrs
Sarah Devriese
Renee Francese
Roxanna Frary
Leslie Godfrey
Joyce Hoopes
Gordon Johnson
Colin Leek
David Manthei
Craig Markey
Tracy McEvoy
Michael Mitchell
Cliff Preston
Jessica Shirey
Kristen Swaim
Ariel Thomas

Far Left: Joyce
Right: Allan

Above Rear: Cliff, Colin, Ariel, Leslie, Gordon, Brandon, Roxy, Jessie

Class of 2010 - Congratulations Grads!

Fall Convocation:

Doctor of Philosophy, Geophysics:

Agnibha Das

Kristopher Davis

Yuanzhong Fan

Rituparna Sarker

Jia Yan

Master of Science, Geophysics:

Yongxia Lu

Yong Ma

Colin Melvin

Ibrahim Mustafayev

John (Will) Waters

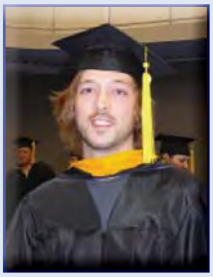
William Woodruff

Bachelor of Science, Geophysical Engineering:

Bo Beins

Alexander Radelet

Orion Sandoval



Above: Will, Bo, Alex, Orion

Left: Fan, Kris, Ritu, Agni, Jia, Prof. Mike Batzle, Prof. Yaoguo Li, Prof. Ilya Tsvankin, Prof. Terry Young

Welcome to Justine Gomez, Administrative Assistant, Reservoir Characterization Project and Shingo Ishida, Communications Specialist, Center for Wave Phenomena. Justine joined the department in July 2010 and Shingo in April 2011.

The Department of Geophysics graciously acknowledges the following individuals and entities for their generous support of department and student activities during the 2010-2011 academic year. Thank you for your continued support!
Anadarko Petroleum; BP America; BP Corporation North America Inc.; Rutt Bridges; CGGVeritas; Chevron Corporation; ConocoPhillips; Devon Energy; ExxonMobil; Global Geophysical; Hess Corporation; ION; Marathon Corporation; Newfield Exploration; Schlumberger/RPSEA; SEG Foundation; Sercel; Shell Oil Company; TGS; US Department of Energy

Congratulations to Professor Roel Snieder on receiving the 2011 Outstanding CSM Researcher Award for senior faculty!

Roel has also been busy with the new graduate course "Introduction to Research Ethics" in the new Center for Professional Education:

The Colorado School of Mines (CSM) aims to integrate elements of ethics training in the curriculum of the CSM. For this reason, former Provost Steve Castillo initiated an Ethics Across the Curriculum committee that is co-chaired by Roel Snieder (Geophysics) and Carl Mitcham (Liberal Arts and International Studies). Starting this initiative was timely, because the National Science Foundation now requires that all students and postdoctoral fellows that are funded by this organization receive training in ethics.

Roel and Carl started the new graduate course "Introduction to Research Ethics" (SYGN502) This course proved to be such a success that now two section of the course are offered. The class is co-taught by teachers from liberal arts and science/engineering to ensure that students meet a variety of view on research ethics. The course goes far beyond behavioral issues such as plagiarism and makes students think about the impact of their work. The class ends with every student writing and presenting his or her personal ethics statement.

Earlier, Roel developed the course "The Art of Science" that annually is taken by about 60 graduate students. He currently is setting up a new Center for Professional Education that aims at promoting, coordinating, and initiating training for graduate students in general professional skills.

Congratulations to Geophysics Professor Dave Hale and department head, Terry Young, on receiving the 2010 and 2011 (respectively) faculty award for Best Teacher in Geophysics, voted by the senior class Thank you, Dave and Terry, for your passion and dedication to students and faculty!

Mark your calendars! The CSM alumni luncheon at SEG San Antonio will be held on Tuesday, September 20, 11:30am, location to be determined. For more information, please see Michelle Szobody at the CSM booth or contact her directly at mszobody@mines.edu. See you there!

The Undergraduate Bucket List

Essau Worthy-Blackwell, GP Senior

So you have decided to spend the next four, five or nine (just kidding!) years of your life obtaining a degree in Geophysics from the Colorado School of Mines. The following is a "Bucket List" of things to do while "serving your time" here:

10. Visit the candy bowl at Dawn's desk everyday (some days more than once!)

9. Golden City Brewery - Golden's second largest brewery. Best visited on a brilliant sunny afternoon when you really should be studying.

8. Ask Dr. Hale why he doesn't teach students a "real programming language" like FORTRAN. You may want to duck flying erasers.

7. Ask Dr. Li about the science of Dowsing. (See #8.)

6. Coors Tour on a Monday – That lab report due tomorrow will practically write itself!

5. Hike North Table Rock - unlike South Table Rock or the Geology Museum, you can visit North Table Rock without ever being forced there to learn something.

4. Field Camp – Stand back world! We're about to do Science! (Joke unapologetically stolen from xkcd.)

3. Float Clear Creek - Inner tubes can usually be bought around Golden, or borrowed from an upperclassman.

2. Coors Tour on a Friday – All the fun of a Monday visit, relatively guilt - free. Thirty ounces of freedom awaits!

1. E-Days! For four days in March, students from surrounding campuses will visit Mines for the events, concerts and parties. - True Story.

Our sincerest gratitude and appreciation go out to the brave men and women of the Golden Fire Department and all of the additional crews who assisted with containment of the Indian Gulch fire that burned nearly 1500 acres in the foothills above Golden in March. Thanks to their efforts, no injuries were reported and no structures were lost. Above: the Bravo Boys of the Genesee Fire & Rescue, including Geophysics Professor and GFR Captain Roel Snieder (second from left). Below: Air support.

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

Nonprofit Organization

U.S. Postage Paid
Golden, Colorado
Permit No. 7