

Department News



Department Head Welcome

Hello Friends and Alumni! The Mining Engineering Department has had a wonderful year. We have framed a strategic plan that will bring us to a leadership position among our national and international peers, and we have launched a funding drive that will guarantee our success. Our expanding collaborations with industry and alumni has rejuvenated faculty and students alike. We are on the move!

Donations and Gifts

In the two years since I arrived on campus, we have been blessed with funding that includes two endowed chairs (the Timothy J. Haddon/Alacer Gold Chair and the Fred Banfield Distinguished Chair). We welcomed the Hugh and Ann Evans donation (>\$400k) to support renovation of Mining Engineering offices and classrooms, and the Fred Banfield/Mintec donation to support renovation of the departmental computer classroom and laboratory. We also received funding for four new student scholarships.

Freeport-McMoRan made a gift to support the renovation of infrastructure at our Edgar Mine, and we had a special event at the Edgar in celebration. The first claim at Edgar was staked in 1865, so in September we held a birthday bash to celebrate Edgar Mine's 150th Birthday. Renovation of the Edgar and the department space on campus is ongoing as I write, and we all look forward to getting to use our new state-of-the-art facilities. If you missed the 150th birthday for Edgar, be warned that we plan another celebration in 2021 – the 100th anniversary of the acquisition of Edgar by CSM.

Planning for the Future

Our strategic plan includes continued work at Edgar – including construction of two new buildings: one of which has office space for researchers and a “dry” for men *and* women, and the other has a new classroom and space for the CSM Mine Rescue Teams and their equipment. We also plan to construct some permanent buildings to support the Explosives Engineering Laboratory on the hill above Edgar, and a renovation at the Earth Mechanics Institute (EMI), including new office space, rock preparation and testing lab, and computer facilities. We have outgrown our space in Brown and need to be thinking toward the future.

All of this means that I have my work cut out for me, and I will be working hard to increase our connections to alumni and corporate and foundation partners through various programs and events. The department is mobilizing Industry Advisory Boards to support the department, Edgar Mine, EMI, and AXPPO (the explosives research team) as part of stepping up its engagement. Our very successful Mine Safety and Health group continues to be highly productive and appreciated by the industry, and we have decided to expand the vision for this team – establishing EMCIS (the Energy, Mining and Construction Industry Safety) program. We are searching for a new director who can take this important area of Mining to new levels of service to the broadened definition of extractive industries.

We have also developed several new collaborative opportunities for students, including a partnership with Alight, Inc. in San Francisco, beginning with two student internships in the summer of 2015, and the first offering of a Geothermal Field Camp involving CSM and Japanese students and faculty this past summer.

Growth and Change

The department is developing internally as well. Mines recruited three new faculty members into the Underground Construction and Tunneling (UC&T) program. Add this person to the



Inside This Issue

Faculty Perspectives	3
Awards & Recognition....	5
Student Achievements.....	6
Department Updates.....	8
Events of Note.....	10
Department Research.....	11
Publications.....	12

Special Points of Interest

- Meet the new faculty, Dr. Eunhye Kim, on page...2
- Read about what students have been up to on pages...6-7
- See how we are expanding our international partnerships on page...7
- The Edgar Mine celebrated it's 150th Birthday. Read about the celebration on page...10
- Find out what big events are coming up on page...12

Research and Adjunct Faculty

We want to thank and recognize our research and adjunct faculty for all they do for our students:

Brian Asbury, Research Associate & Manager of EMI
Carl Brackpool, Research Associate
Larry Clark, Research Associate
Dr. M. Stephen Enders, Research Professor
Dr. Ryan Garvey, Research Assistant Professor
Dr. John Grubb, Adjunct Professor
Dr. Mark Hart, Adjunct Professor
Dr. Ray Henn, Adjunct Professor
Paul Jones, Adjunct Professor
Dr. Andrew Schissler, Adjunct Professor
Matt Schreiner, Research Associate & Manager of Edgar Mine
D. Erik Spiller, Adjunct Professor
David White, Research Associate
William Wilson, Adjunct Professor
Dr. R. Karl Zipf, Research Professor

Mining Engineering Staff

Special thanks go to our hardworking Mining Engineering Staff:

Melanie Barnhart, Program Assistant
Emilia Clayton, Research Admin Support
Truman Beran, EMCIS Assistant
Clinton Dattel, Edgar Mine Superintendent
Robert Ferriter, Senior Mine Safety Specialist
Ray Johnson, ERL Lab Manager, AXPRO
Michelle Reiher, Director of Training- EMCIS
Alex Robles, Training Coordinator- EMCIS
Bruce Yoshioka, Lab Coordinator

Meet the New Faculty

Dr. Eunhye Kim

Dr. Eunhye Kim joined the Mining Engineering Department on July 1, 2015 as Assistant Professor. After completing a dual BS (Civil Engineering and Computer Science) and an MS (Civil, Urban, & Geosystem) in Korea, she attended Pennsylvania State University where she earned her Ph.D. in Energy and Mineral Engineering with an emphasis in Mining Engineering (drilling optimization) and a minor in Engineering Mechanics. For mining and rock mechanics societies, she serves on the Young Leader Committee in SME as well as in ARMA as a Future Leader.

Dr. Kim has four main research projects focused on (1) analyzing and evolving (improving) EMI rock mechanics database (2) drilling bit optimization, (3) rock mechanics and rock fragmentation, and (4) stability of underground structures. In addition, she is actively involved in Earth Mechanics Institute and Center of Underground Construction and Tunneling. Also importantly, she is currently building collaborations with industry in the area of geostructure stability, cutting mechanics and drilling tools in an effort to make a safer workplace and cost-effective processes. She looks forward to visiting mines, when able, to learn about local and national mining problems and become more familiar with the industry.

In the Fall 2015 semester, Dr. Kim taught "Underground Design and Construction" at Mines. Additionally, she will teach separate undergraduate and graduate tunneling classes in Spring 2016. She is working on developing a new class in mechanical excavation. She really enjoys working with students and conducting independent study with undergraduate students.

Department Head Welcome, cont.

five who were here when I arrived and the three that joined in 2014 – we now have a Department of nine, with two more joining us as we fill the new endowed chairs.

We have developed new courses in Geothermal Engineering, Explosives Engineering, and improved our graduate courses in underground and surface mining. The Department is reworking its undergraduate and graduate curricula, and we have made it a goal to increase the number of mine visits and field trips for the students in all classes.

Community and Connections

Involvement with CSM is strong as Mining Engineering was invited to participate in several activities on campus including the Boetcher Scholars Receptions, Discover Mines, Mines by Starlight, Alumni weekends, and Celebrate Mines. We have hosted many groups of visitors, including students from Brazil and delegations from Ecuador, China, Kazakhstan, Australia, and Morocco. In addition, with the CSM Foundation and Freeport-McMoRan, the Department organized an August tour for 60 Mines students, faculty and administrators (including President Paul Johnson and Dean Ramona Graves) to the Henderson and Climax Mines. What a day that was!

I look forward to hearing from you, and invite you to consider how you can support the Department in the New Year of 2016. Funding for facilities and for faculty and student support is always appreciated. I also invite you to share your ideas, provide data and opportunities for student internships and faculty research, and support our goal to increase student mine visits. And of course, let me know how we can better serve you and the mining industry.



Dr. Kim cleaning up debris after a rotary cutting experiment in PA.

By the Numbers

2015 Department Scholarships: 45

Undergraduate Degrees

CY 2015 graduates: 43

New scholarships established in 2015: 3

2015 student summer internships: 36

Graduate degrees

Total Grad Students enrolled AY 14-15: 60

Total MS degrees

CY 2015: 17

Expected AY 2015/2016: 18

Total PhD graduated

May 2015: 2

December 2015: 3

Expected 5/2016: 3

Faculty (tenure and tenure track) – 11
(Nine filled with two open positions.)

Recruitment for faculty positions (Alacer Gold/Haddon and Banfield Chairs) are proceeding with Alacer in the second round of interviews.

Faculty Perspectives

Dr. Elizabeth Holley

I've had a fantastic first year in the Mining Engineering department, and I want to thank my colleagues, our staff and Department Head Priscilla Nelson for the support in my transition from Geology and Geological Engineering last fall. The administration charged me with the task of strengthening the ties between geology and mining across campus, as well as improving the geological components of the curriculum for MN students. I've been working hard to meet those challenges in the classroom and the research arena.

We are currently revising the geology curriculum to make the courses more useful for mining engineers. Dr. Nelson and I team-taught "Earth Materials and Resources for Mining Engineers" in the Fall semester, and we've shifted the emphasis towards case studies that teach the students how to apply geoscience skills to mining problems. A few examples: students learned about how stratigraphy influences slope stability through case studies from the Carlin trend in Nevada, how mineralogy creates differences in rock strength in an example from a tunneling project in Rochester New York, and how plate tectonics and seismicity impact large engineering projects in a case study on the proposed Pebble mine in Alaska. My goal is to arm our students with an appreciation of the role of geoscience throughout the mining life cycle, and the fundamental geoscience skills to meet the challenges and opportunities that geological complexity provides!

At the graduate level, I plan to offer another Mining Geology field course next spring. Last year we visited six active mines on the Carlin trend and Battle Mountain districts, Nevada, as well as Virginia City and the historic Comstock lode. Students had the opportunity to observe mining operations first-hand, including the new SX-EW plant at Phoenix, underground operations at Turquoise Ridge, Newmont's Carlin South processing, exploration drilling and a blast at Marigold, and numerous other high-impact experiences. I believe strongly that field visits are a key ingredient in helping our grad students make the leap from university to the real world, and I'm deeply grateful to our fabulous hosts at Newmont, Barrick and Silver Standard. If you'd be willing to host a site visit or help our students cover travel expenses for our next trip, we'd greatly appreciate your support.

On the research front, I'm proud to announce that my Mining Geology Research Group is growing! I have seven top-notch graduate students forming an interdisciplinary team of geologists (GGE) and mining engineers (MN), and we're working on projects that leverage geological tools to address research questions throughout the mining life cycle. I have seven active research projects, which I would be happy to discuss in depth if you contact me directly.

Thanks for your support, and I look forward to engaging with you on any and all topics at the intersection of geology and mining engineering! Stop by for a visit, or I can be reached at eholley@mines.edu.

Dr. Hugh Miller

It's been a very busy and productive year. I've had the pleasure of teaching both undergraduate and graduate courses the last two semesters, including Introduction to Mining, Small Mine Operations, and the Senior Capstone Design courses. While the time commitments associated with Senior Design can sometimes be overwhelming, it's extremely rewarding to work with these talented students, as well as with my co-instructors, Bill Wilson and Paul Jones. In addition to academic courses, I've been involved in several projects related to continuing education and executive management that focuses on assisting top rated and innovative companies, such as KGHM Poland, OCP, and Sandvik. My other major projects this year include the Western Mine Safety Training Program sponsored by CDC NIOSH and activities intended to facilitate Capacity Building of the Mineral Sectors of Afghanistan in collaboration with the U.S. Geologic Survey.

My graduate students are working in a wide range of research activities that include: hydro-excavation/waterjet technology, dredging systems, borehole mining, supply chain management, pre-production (EPCM) costing & scheduling, and material comminution. This spring, we'll begin research into some exciting new areas associated with laser drilling.

This year I've had the honor of Chairing two important SME committees devoted to addressing the major challenges facing U.S. academic degree programs in mining and mineral processing. Through the efforts of many, along with the generous support of the Society's constituencies, SME was able to offer three Ph.D. Fellowships and two Career Development Grants to worthy candidates in hopes of developing the next generation of faculty. A second round of awards will be made in 2016.

Among my many other service commitments, a couple stand out. They include serving on the SME Board of Directors, chairing an upcoming industry short-course on commercial waterjet applications and technical basics, the redevelopment activities at the Edgar Experimental Mine and the Earth Mechanics Institute (EMI), and our on-going departmental strategic planning and curriculum review. By the end of 2015, I also hope to complete a text book focused on introductory topics related to mining engineering and resource extraction that I'm assisting Dr. Bill Hustrulid in editing. I want to express my sincere thanks and appreciation for all your support of our department and students. Your involvement in CSM is a major reason that we're able to provide a world-class education to students and prepare them for successful careers in industry. If I can be of any assistance, please let me know. Thank you.



CSM students and Silver Standard hosts at the Marigold Mine, Nevada in March 2015.

Faculty Perspectives, cont.

Dr. Jürgen Brune

This past year has provided me with new experiences and opportunities. I was named the Interim Director of EMCIS-TRIP, which has been an exciting challenge as we develop this program mine safety training and research program to serve other industries including construction and oil and gas, and eventually develop an academic degree program as well. This summer EMCIS won two federal grants totaling \$800,000 for mine safety and mine rescue training.

In July, I taught a short course organized by the Education Foundation of the Colorado Mining Association, "All About Mining", educating K-12 teachers about the importance of mining and mined products in our daily lives. That month I was also elected Editor-in-Chief for *Mining Engineering and Transactions*, a peer reviewed publication by the Society for Mining, Metallurgy and Exploration (SME). I have been an Associate Editor for this journal since 2008. I also became an ABET Program Evaluator this summer.

I won awards for several research proposals in the past year. Karl Zipf and I won a proposal to NIOSH for \$104,000 to build a rock dust explosion testing facility at the Edgar Mine. I was awarded a proposal for \$94,000 to CDOT to conduct modeling and develop fire emergency management strategies for the Eisenhower Tunnel.

My undergraduate and graduate students are doing well. Through my research, I provide various levels of financial support to three undergraduate students, nine graduate students and one post-doc. I had two PhD students, Jon Marts and Richard Gilmore, successfully defend their dissertations. Two of my undergraduate students, Katherine Jennings and Levi Rawlings, presented at the International Mine Rescue Body Conference in Germany in September. Under my supervision, I had nine undergraduate and graduate students submit technical papers to the Society for Mining, Metallurgy and Exploration (SME) to present at the Annual Meeting in Phoenix AZ in February 2016.

Dr. Kadri Dagdelen

I continue to teach "Surface Mine Design" and "Introduction to Geostatistics". I am also working on a Newmont sponsored research project on the development of a stochastic production scheduling algorithm that takes into account grade uncertainty during mine planning with my two PhD students Ady Van Dumen and Canberk Aras. I am teaching short courses and currently serving as a non-executive director of Randgold Resources Board. Randgold Resources is a well-managed gold mining company with five open pit and underground gold mining operations in West Africa and DRC. I am enjoying very much travelling to Africa to visit and observe various mining operations and bring back and share the knowledge gained with my students. I am actively involved with fund raising for faculty support and student scholarships on behalf of the Mining Department.

Sandvik Graduation Ceremonies

Dr. Jürgen Brune attended the final exams and graduation ceremony for the Sandvik Short Course at the University of Leoben, Austria in October, 2015. Non-mining engineering professionals from mining equipment manufacturer Sandvik attended this short course to gain knowledge about mining engineering. Over the last two years, six two-week modules were taught to the Sandvik students at Colorado School of Mines, Montan University Leoben (Leoben, Austria), University of New South Wales (Sydney, Australia), Camborne School of Mines (Penryn, U.K.), the University of the Witwatersrand (Johannesburg, South Africa) and the University of Luleå (Sweden). The Sandvik program has run for over seven years and produced 136 graduates from 26 countries.

The pictures show Dr. Brune delivering the Graduation Address at Aula of Leoben University, a mining dance performance and the students taking the traditional "Ledersprung" or "Jump over the Leather", a ritual of passage into a new rank as "International Mining Engineer". Candidates drink a beer, call out their name, rank and a personal motto, then jump off a beer barrel and across a special leather apron that miners wear on their back as they scoot down the slide into the mine. Everyone wore the traditional Bergkittel, a mining uniform work for all official and black tie events in the European mining industries.



Dr. Kaunda with Dr. Bunda Besa, Mining Engineering Department Chair at University of Zambia).

Dr. Rennie Kaunda

What a busy year it has been! At the end of the 2015 spring semester I travelled to Montreal Canada to present a paper on rock mass characterization at the International Society of Rock Mechanics ISRM Congress 2015 conference. After that I travelled to Brooklyn seeking potential research collaboration in slope stability problems. During the summer I then helped supervise 10 undergraduate student interns from Brazil working on various rock mechanics projects at the EMI with Brian Asbury. In July-August I visited the mining engineering department in Zambia, where we are trying to initiate international research and educational collaboration. This year I was also fortunate to publish articles on two key topics: internal erosion in Computers and geotechnics, and Waste rock shear strength in international journal of mining and mineral engineering. I have now recruited three graduate students. Alex is working on true triaxial rock testing, remote characterization of rock deformation in underground mines, and Shrey is working

on underground mechanical excavation in sensitive materials. I have also been working with a very motivated undergraduate student, Michael, who has been doing rock tests on shale producing quite insightful results we are getting ready to publish. On the grant front we got an NSF award along with Dr. Holley and Dr. Nelson to study thermal induced damage in rock using microwaves.

Faculty Perspectives, cont.

Dr. Masami Nakagawa

I took my sabbatical leave in Japan during the spring semester and part of the summer, so many international events took place from there. In April, at the World Geothermal Congress in Melbourne, I delivered a presentation, chaired a session and co-organized a well-attended opening panel session called "Community and Indigenous Involvement in Geothermal Projects". In June, I was invited to deliver a talk on sustainable geothermal energy at the International Student Energy Summit in Bali, Indonesia. During my stay in Indonesia, I also visited the ITB (Bandung Institute of Technology) to learn about and evaluate their geothermal energy curriculum. In August, I organized a two-week long geothermal field camp in Rico, Colorado. This became an international geothermal event with a group of 5 participants from Tohoku University and Central Research Institute of Electric Power Industry in Japan. Conducting Thermoluminescence measurements of surface rock to correlate to the past geothermal activities was exciting and added a very interesting insight into Rico's geothermal potential. Most recently, from September 18th to 23rd in El Salvador, I was invited to deliver a short course on geothermal energy development with a special emphasis on community sustainability aspects of natural resources development. This was jointly organized by JICA (Japanese International Corporation Agency) and La Geo in El Salvador.

Other highlights from the past year include participating in writing two major geothermal proposals in Japan, working on a special edition on recent advances in geothermal for the American Institute of Physics, and finishing a 100' core drilling and a 30' over-core drilling at Edgar Mine for a DOE geothermal project. This project was to develop a small geothermal circulation system to conduct heat/mass transport research with NREL and Sandia National Laboratories.



Dr. Nakagawa doing mountain training for geothermal exploration in Japan.

Bruce Yoshioka

Overall, it was an incredibly busy Summer for me on campus. The majority of my time was spent coordinating the Edgar birthday party and departmental construction activities, as well as providing support for the Kroll Institute Mineral Processing Short Course and several Brazilian students conducting research at CSM. Blue Key Honor Society also kept me busy with the planning and execution of a Leadership Retreat, and the M-Climb which was a great success. I have also been asked to join the Colorado School of Mines Emergency Response Team as a junior member.

In October 2014, I became a full member of NecroSearch International (NSI), a volunteer multidisciplinary team dedicated to assisting law enforcement in the location of clandestine graves and the recovery of evidence, including human remains. This past June, I had the privilege of being an instructional team member providing a week long training session for 12 law enforcement and crime scene investigators from throughout the U.S. This training included technologies and techniques for the detection of surface and subsurface features indicative of a burial, as well as archeological techniques for exhumation of remains and the preservation of evidence. I have also been elected to serve as an NSI Media Committee and Research Committee member.

Awards and Recognition

Mining Global magazine named Colorado School of Mines as the top mining school in the United States.

Bruce Yoshioka represented the CSM Blue Key Honor Society chapter when the Student Activities office received a civic service award from the Golden Chamber of Commerce in January, 2015.

Dr. Priscilla Nelson received the Excellence in Education Award, Taiwan Rock Engineering Symposium, Chaoyang University of Technology, 2014 and was named an Honorary Member, The National Society of Leadership and Success, 2014.

The Business Journal ranked Colorado School of Mines as the best public school in Colorado, and number 53 across the nation, in February 2015.

Associate Professor Dr. Hugh Miller received a President's Citation award at the 2015 Society for Mining, Metallurgy, and Exploration Annual Meeting.

Professor Jürgen Brune was voted Mining Engineering's Outstanding Faculty in the annual CSM faculty forum in May.

Dr. Nelson was identified as one of the "100 Inspirational Women in Mining" by the organization Women in Mining, (UK), 2015.



Receiving the Golden Chamber of Commerce Civic Award (from left): Chemical engineering student Daniel Jost, Mining Engineering Department Laboratory Coordinator and Blue Key Advisor Bruce Yoshioka, Associate Director of Student Activities for Student Organizations Travis Smith, Engineering Physics student Nicholas Booth and Sigma Nu Advisor Erik Boutwell.

Student Achievements

Competitions

The CSM Mine Rescue Team competed in a regional mine rescue competition in Rolla, MO. They were one of four student teams competing alongside 17 professional/corporate teams. Our team came in 17th in Field, 6th in First aid, and 16th Overall.

The CSM Mine Rescue Teams also competed over spring break in the Nevada Regional Mine Rescue contest. Mines students competed with eight corporate mine rescue teams from Nevada mining companies and completed additional training. The CSM Silver team won 2nd place in the First Aid competition, where teams render advanced first aid and assess and prepare a patient for transport, while the CSM Blue team won First Place in the Smoke Chamber competition, where teams must investigate and map an area of a mine that is filled with smoke. The contest was judged by the federal Mine Safety and Health Administration. You can see some highlights from the competition in this video photo collage compiled by Mining Engineering senior Joe Waite: <https://vimeo.com/122220739>



A group photo of the two teams at Winnemucca, taken during a vehicle extrication training they completed with the help of the Newmont Mine Rescue Teams and the Elko Fire Department.



Ladies Silver team in the First Aid competition at Winnemucca.

Collegiate Mine Emergency Response Exercise (MERD) was hosted here once again. CSM Mining Engineering and Mine Rescue students organized the event and invited student mine rescue teams from South Dakota, Montana Tech and UBC to participate in an international student mine rescue contest on campus and at the Edgar mine Feb. 13-14. We also had visitors from the German mining university Freiberg who are building a student mine rescue team. Six student mine rescue teams competed in an underground mine rescue exercises that included working in the Edgar mine under smoke, first aid, a knowledge test, a virtual reality rescue exercise and a technician contest to check and prepare rescue equipment. The contest was supervised and judged by members of Newmont Mine Rescue. CSM Silver won 1st overall and in First Aid, while the CSM Blue ranked 3rd overall.

Mining Engineering had two graduate students participate in the 2015 Conference on Earth and Energy Research CEER. Samuel Lolon did an oral presentation on "Studies of Underground Coal Mine Explosion Prevention using Computational Fluid Dynamics (CFD)", while Robert Duran did a poster presentation on "Application of Discontinuity Multivariate Clustering Analysis in Support of Rock Mass Characterization for a Small Scale Hydrothermal Fluid Flow Study at the Edgar Mine in Idaho Springs, Colorado". Lolon won the department award with a prize of \$150.

The CSM Mine Rescue Teams participated in the 37th Safescape International Collegiate Mining Competition. The games were held in Kalgoorlie, Western Australia from March 25 – 29, 2015. Two co-ed teams participated in the competition in a field of 29 teams from other mining schools across the United States, Australia, Great Britain, and Brazil. The events the teams competed in consisted of mucking, hand steel, swede saw, track stand, gold panning, jackleg, and surveying. The CSM A team placed 5th overall in the competition. The CSM B team placed 8th overall in the competition, with a 3rd place finish in the gold panning event. The team was sponsored by the following companies: AngloGold Ashanti North America, Minesight, Vulcan Materials Company, Golder Associates, Thompson Creek Metals Company, The Tim and Mary Haddon Foundation, Safescape North



Students at Safescape. Top Row (l-r): Eric Lawrence, Cedric de Chermont, Chelsea Pomeroy, Kelly Churchill, Zach Dupont, and Austin Noble. Bottom Row (l-r): Kaylor Peratt, Nicho Cusack, Jordan Rutledge, Andy Lyman, Mike Tinney, and Brett Carlson.

Scholarships and Fellowships

We continue to support our students with scholarships and fellowships. We are thrilled with the creation of three new scholarships and an increase in one of our existing fellowships.

Jerry and Karen Zinc established the Jerry and Karen Zinc Endowed Scholarship Fund which will provide scholarships of a minimum \$1,000 to Mining students in financial need.

Martin Marietta established the Martin Marietta Scholarship and Mining Department Support Fund. This will award two yearly scholarships of \$3,000 each to undergraduate Mining students based on financial need.

Matt Juth, Manager at Atlas Copco, and Lee Fronapfel have also created a new scholarship. The Atlas Copco/Fronapfel Scholarship will be awarded to Mining Engineering juniors and seniors, with additional consideration given to students who are working.

The Resource Capital Funds Graduate Fellowship was increased from \$20,000 to \$35,000 per student; special thanks to senior partners and CSM alumni Ryan Bennet and Ross Bhappu. We also have the McQuiston Fellowship for graduate students.

We now have five scholarships available for both graduate and undergraduate students, and 36 scholarships available specifically to undergraduate students.

Student Achievements, cont.

America, Freeport McMoRan Copper and Gold, Colorado School of Mines Earth Mechanics Institute, and CSM Edgar Experimental Mine.

The following students participated in the Safescape competition: Nicho Cusack, Kaylor Peratt, Cedric de Chermont, Jordan Rutledge, Andy Lyman, and Eric Lawrence on the CSM A team and Kelly Churchill, Zach DuPont, Mike Tinney, Chelsea Pomeroy, Brett Carlson, and Austin Noble on the CSM B team. The Faculty Advisor was Matt Schreiner.

Community Outreach

The CSM Mine Rescue Team arranged for a practice landing of a Flight-for-Life helicopter to practice loading a patient on the helicopter. This event was coordinated with various campus departments who participated in arranging for security and safety during the landing.



MN Students from left to right: Clancy Harman, Jacob Milleville, Katherine Jennings, Nicole DeMontigny, and Hanna Steadman

several SME members including Hanna Steadman, Katherine Jennings, Clancy Harman, Jacob Milleville, and Nicole deMontigny. The day's activities included several hours of classroom work and a trip to our Geology museum here on campus.

They are working together with the Minerals Education Coalition of the Colorado Section of SME and the Boy Scouts of America Denver Area Council to host and promote another event early in the Spring 2016 term. The students are very excited to continue working with and teaching the scouts and look forward to taking them on a tour of the Edgar Mine or another local mine in addition to completing the classroom work. They hope to make this an annual event and show as many scouts as possible the importance of the mining industry.

Graduate student Eduardo Lozano Sanchez was invited give a guest lecture for CSM's EPICS on October 2, 2015. The EPICS students greatly appreciated his presentation on land mines.



Eduardo Lozano Sanchez presenting to EPICS.

Internships

Our undergraduate and graduate students are serving internships all over the US, and even the world, including at Dal-Tile, Arch Coal (Thunder Basin Coal Company), Cripple Creek & Victor Gold Mining Company, Helca Mining Company, Alight, Lhoist North America, Crab Orchard and Anderson Mines, BHP Billiton, Stillwater Mining Company, Newmont Mining Corporation, Lehigh Hanson, Round Mountain Gold Corp (Kinross), Technical University Bergakademie Freiberg (Germany), Joy Global Mining Machinery, GE China Mining Business, Freeport McMoRan Technology Center, CTL Thompson, and Magnus Pacific Corporation. For a full description of the internships, go to <http://mining.mines.edu/Mining-Newsletter>.

International Program Developments

The CSM Mining Engineering department continues to develop partnerships around the globe for educational and research purposes. The partnership with USGS to grow human capacity and knowledge about earth resource development in Afghanistan continues apace. We also had faculty help deliver courses for the KGHM Executive Academy, including executives from KGHM mining operations, in Poland, Canada, the U.S, and Chile. Meetings were held with government and academic delegations from several countries, including Peru, Morocco, Kazakhstan, Ecuador, and China.

We are working on developing research and educational partnerships and collaborations with other universities, including the University of Leoben (Austria), Bergakademie Freiberg University (Germany), Technical University of Delft (The Netherlands), Curtin University (WASM) (Australia), and Nazarbayev University (Kazakhstan). We are also talking with CRC Mining (U. Queensland, Brisbane Australia) about developing a research partnership.

These opportunities are not limited to academia as we are also working with several corporate organizations. For example, we met with Hochtief and many other companies in Peru regarding developing a research and education partnership. Discussions with Rio Tinto Iron (Australia) on developing graduate/internship program and research are also underway.

Our collaboration with OCP, one of the world's leading producers and exporters of phosphate ore, phosphoric acid and fertilizers, has already begun. We conducted ten one-week mining courses for OCP at their training center in Marrakech, Morocco. Courses started in December 2014 and will be completed in mid-2016. As part of the course, a group of OCP senior managers and technical staff participated in a mine tour in October 2015, visiting an underground sodium carbonate mine and three surface mines in Wyoming and Colorado. The group also toured four MN labs and the U.S.G.S. National Earthquake Information Center on the Mines Campus, guided by Dr. Haley Benz, Director of the National Earthquake Information Center.

Mines faculty for the course series include Dr. Hugh Miller, Dr. Kadri Dagdelen, Dr. Rennie Kaunda, Dr. Corby Anderson and Bill Wilson who also serves as the class and tour coordinator. Other faculty for the course series include Dr. Jessica Kogel of IMERYS' North American, Barb Filas, international mining consultant, Dr. Jhon Silva Garcia of the University of Kentucky, and Dr. David Hammond, international mining economist and financial analysis specialist.

Department Updates



Summer interns at the Edgar Mine.

Edgar Mine

This year has been exciting at the Edgar Experimental Mine. With the 150th Anniversary of the facility behind us we are looking to the future with continued education and research and the next 150 years.

Edgar's operations continue to be focused on education, research and training and classes come to the Edgar for laboratories and lectures. In January, with cooperation from Freeport-McMoRan, Henderson Mine and International Roll (IR) Form, we installed the first R&D model of an instrumented Split Set rock dowel. This developing technology will allow engineers to inspect and gather information from Split Sets to verify dowel performance – and this new development will assist with safety and un-

derstanding of rockmass behavior during mining. In addition to the IR split set testing, several other companies have used Edgar for equipment testing and development, including several different developers and manufacturers of Through-The-Earth radio systems, instrumentation and sensors, and drones for underground exploration.

Through new research projects around sensors, software and ventilation, the Edgar is getting a jump on new equipment and telecom infrastructure that would be specified in the future development plan. Technology corporation NTT is an outsider to mining, however is bringing innovation from its Silicon Valley research lab to address safety and compliance opportunities. The first project through Research Associate Carl Brackpool is to tie existing mine ventilation hardware into a system that can scale as the Internet of Things (IoT) revolution and its prototyping ecosystem result in more connected devices and mechanical systems. The project alone will result in a permanent Fiber Optic backbone throughout the Edgar, by mid-December, with wireless Access Points provided by Cisco Meraki and Zigbee sensor gateways before January 15th.

Mine Rescue training continues to be a mainstay activity at Edgar, and we hosted the Student Mine Rescue contest with participating colleges and universities from across the country. Cooperation with the State of Colorado Mine Rescue Training Program has led to improvements in the rescue maze and multiple Mine Rescue teams being exposed to the Edgar. And our own EMCIS (Energy, Mining and Construction Industry Safety) program uses Edgar for many training sessions every year.

Several funded research projects are underway at the Edgar. Dr. Nakagawa has a DOE-funded Geothermal project that has recently finished over 100ft of core drilling. Dr. Greg Bogin of Mechanical Engineering and Matt Fig (PhD candidate) have been diligently working on methane ignition experiments.

If you are ever interested in the weather conditions at the Edgar please look up Edgar Experimental Mine on www.wunderground.com for the up to the minute and historical weather conditions.

Earth Mechanics Institute

The Earth Mechanics Institute (EMI) has been a bustle of activity in the past year, with activities at a pace that will only accelerate into 2016. We are currently directly employing eight students working on research and service projects. Last spring there were ten students, and over the summer we had 5 full-time student employees.

Many other students and professors are working on projects at EMI including a group of four students developing dust sampling equipment with Dr. Brune. Several others are setting up a waterjet cutting test facility with Dr. Miller. We also have been hosting two visiting scholars in 2015, and expect more in 2016 from Germany, Austria and Korea, who will be working on funded research projects.

Over the summer EMI also hosted 10 international interns from Brazil who worked on self-directed research projects. These included correlation of rock strength and Schmidt hammer values of rock from the Edgar mine, evaluation of fracture toughness test methods, and statistical analysis of the 26,000+ point EMI rock property data base.

We continue to provide community outreach to the public, as well working with the mining and underground construction industries. These activities include numerous tours and lectures for K-12 groups, UCA's Cutting Edge in Tunneling conference and CMA's All About Mining course for educators; as well as involvement and support for numerous short courses and conferences.

Active research projects that will involve full scale cutting tests at EMI are: microwave assisted rock fragmentation with Dr. Holley, Dr. Kaunda and Dr. Nelson; development of a new drag bit cutting force predictor headed up by Dr. Kaunda; and potash borer miner cutting optimization by Brian Asbury. And more projects will be started as our new UC&T faculty members (Dr. Eunhye Kim in Mining Engineering, Dr. Gabe Walton in Geology and Geological Engineering, and Reza Hedayat in Civil and Environmental Engineering) begin their careers at Mines!



CSM students performing Linear Cutting Testing at EMI.

Energy, Mining and Construction Industry Safety

In January 2015, the CSM Department of Mining Engineering restructured its activities regarding Mine Safety and Health (MS&H) Training, expanding the very successful program to create the Energy, Mining and Construction Industry Safety (EMCIS) Training, Research and Industry Partnerships (TRIP) Program – EMCIS-TRIP. As reflected in the new title, the program now includes a broader range of functions beyond the training activities and research that have been a long-standing strength of the Mining Safety programs at CSM.

The EMCIS-TRIP program is initially directed by Dr. Jürgen F. Brune, Research Professor, and a search is underway to identify the first permanent director. Within the proposed program, the structural divisions include the following:

EMCIS Industry Safety Training: The EMCIS Safety Training activity will continue to provide the existing training programs that have been developed under primary funding from MSHA and NIOSH. This activity will be expanded to provide training for the broad range of heavy construction and extractive industries to include mining, heavy construction, and oil & gas. Additionally, special training will be developed for and provided to the U.S. military as well as civil and government emergency service providers such as fire departments that have an interest in emergency management and rescue services in and from underground and confined space facilities, including subway systems, tunnels, garages etc.

EMCIS Research and Technology Development: Existing Mines faculty and staff have the expertise and interest to develop an exciting research program under EMCIS. An external Advisory Committee will be formed with representation from academic, industry and government sectors, with international representation as well.

The research program will seek funding to support technological innovations to improve safety in our industries. We expect to develop partnerships with industry and government agencies, and will seek to leverage common needs and interests. Expertise required for success in these research projects will be identified and developed through collaborations with external partners and other universities.

EMCIS Engineering Academic Degree Programs: The Department of Mining Engineering also is developing a new graduate degree program in Safety Engineering for the heavy construction and the extractive industries. This degree program will initially be developed for MS level work, with the intention to develop a PhD level program in the future in partnership with other higher education institutions in the area.

Advanced Explosives Processing Research Group

Dr. Petr and his Advanced Explosive Processing Research Group (AXPRO) had a very successful 2015 year. Dr. Petr is continuously improving the Explosives Engineering Minor program with the development of new lectures and field laboratories. In addition to this, AXPRO is working towards developing new courses for a Master's Degree in Explosives Engineering under Mining and Earth Systems Engineering.

This year AXPRO conducted several unique research projects: 1) the development of studies of post-blast fumes from ANFO, 2) the development of safety distances for the Colorado Department of Transportation (CDOT) crew during avalanche control missions using explosives, 3) conducting the validation and testing of the new “case charge” used for avalanche control missions in Colorado, 4) the establishment of a new consortium program for CDOT's Avalanche Control team, 5) the completion of a 3.5 year long research program, in June, with LANL and Oil and Gas Partner, and 6) a new contract was established for the installation of a new post blast fume chamber, which has the capabilities of withstanding 10 kilograms of explosives, and allows AXPRO to measure different NOX gases after detonation.

The AXPRO team (Ray Johnson, John Lipka, Steve Beggs, and Whitney Dean) and Dr. Petr have conducted very successful short courses including, the “Practical Explosive Training School” (PETS) and High-Speed Imaging for Explosive Engineering, with both industry and government support.

The Practical Explosive Training course ranges from basic introduction to advanced explosive use. This course is designed to teach state explosive permit applicants (new and renewals) the proper methods of explosive storage, handling, and use. The two-day course is a collaboration

between the Department of Labor and Employment and AXPRO. In August, AXPRO was invited to conduct this training for 14 instructors from the Security and Emergency Response Training Center (SERTC) in Pueblo, Colorado.

As world leaders in digital high-speed imaging and explosives education, Vision Research and AXPRO of Colorado School of Mines, conduct a university-level short course on high-speed imaging's wide range of applications with a focus on experimentation with explosives and ballistic applications.

Finally, AXPRO was granted a new 5-year contract with CDOT (via renewal by CDOT) on avalanche control training. Each year we train over 110 CDOT personnel in explosives avalanche control.



Events of Note



The EAGER project leaders: Dr. Elizabeth Holley, Dr. Priscilla Nelson, and Dr. Rennie Kaunda.

Graduate and undergraduate students from Mining Engineering and Geology had the opportunity in March to attend a course on using Vulcan software taught by CSM alumni Ann McCall. The three-evening course taught students the Vulcan interface, designing CAD data, importing drillhole data, and using visual analysis tools to see ore zones, as well as using triangulations to model open pit mines, orebodies, and underground development. McCall even added a special fourth session to help students with Senior Design projects in Vulcan.

In hopes of promoting increased social, economic, and political stability in Afghanistan, faculty from the CSM Mining Engineering Department organized 7 short courses and training exercises over the past 3 years in collaboration with the U.S. Geologic Survey International Program to build mining related technical and economic capacity within Afghan government agencies and universities. As part of this effort, the CSM Mining Engineering Department hosted a campus visit April 29-30th for a high-level delegation from the Afghanistan Ministry

of Mines and Petroleum; which included his Excellency Dr. Dauod Shah Saba, Minister of Mines and Petroleum, and several representatives of the U.S. Department of State, MIDAS Program, and foreign aid groups. The delegation toured campus laboratory facilities in the Mining and Petroleum Departments and engaged in dialog with several faculty members about mineral investment, regulatory structures, sustainable development, and modern mining practices. Through the assistance of CSM Mining faculty, tours and meetings for the delegation were also arranged at several mines and government agencies, including Climax Molybdenum Henderson, Cripple Creek & Victor Gold, Freeport-McMoRan Morenci, and the U.S. Bureau of Land Management's Training Facilities in Phoenix, Arizona.

The department hosted 10 Brazilian college students and three CSM students in a summer of self-defined undergraduate research projects through the Earth Mechanics Institute. We plan to continue these research opportunities through undergraduate fellowships and internships year-round.

We successfully prepared for, convened, and concluded activities of the President-appointed Department Visiting Committee – the department and its people and programs received a strong thumbs-up from the Visiting Committee.

The department worked with Dr. Kathleen J. Hancock for LAIS student presentations on political risk assessments for earth resources.

MN Faculty received a National Science Foundation (NSF) grant to support innovative mining and rock mechanics research leading to faster and more efficient underground construction operations. This will be collaborative research with the University of Leoben on microwave-induced damage on rock. This project, known as EAGER, is our department's first funding from NSF in MANY years.

Edgar Mine's 150th Celebration



A picture from the Edgar Mine in 1963.

The first claim at the Edgar was filed in 1865, and in 2015 all of CSM gathered at the Edgar Experimental Mine for a 150th birthday party on Sept. 19. In the 1870s, the mine produced high-grade silver, gold, lead and copper. CSM bought the mine in 1921 and today, as a unique hands-on underground laboratory for future engineers, the mine provides students with valuable experience in underground mine surveying, geological mapping, rock fragmentation and blasting practice, mine ventilation field studies, rock mechanics instrumentation practice, underground mine unit operations, rescue training and mine safety.

The party included an underground mine tour with a blast simulation, historical and proposed renovation displays, a kids photo booth, gold panning, Mine Rescue Team demonstration, a grizzled prospector costume contest, and a mining collectibles silent auction. Erik Poeck (CSM PhD student) was on center stage with his voice and guitar, and singer/musician Rex Rideout also performed. A wonderful time was had by all, with attendees numbering almost 1400 and including notables such as President Paul Johnson and Dean Ramona Graves.

Dr. Nelson described Edgar Mine as the "heart of the Mining Engineering Department, and in the heart of every one of our graduates. Student activities at Edgar build the knowledge, self-confidence and leadership skills that the world expects from Mines grads. With Edgar, the Mines learning experience is truly unique."



President Paul Johnson and Dr. Nelson, wearing a Ramona Graves wig, emcee the celebration.



Students demonstrate first aid on Dr. Nelson.

Department Research

New Research Grants Awarded to Faculty

Project Title or Description	PI/Co-PIs	Sponsor	Amount	Project Dates
Enhanced Safety and Health Training for Western Mine Workers	Hugh Miller and Michelle Reiher	CDC NIOSH	\$576,000	9/1/2015-8/31/2016
Establish coal dust explosion prevention test facility at the Edgar Mine.	Jürgen Brune	CDC NIOSH	\$104,120	9/1/2015-8/31/2016
Exploratory Research on Rock Damage from Geologic and Induced Thermal Loading (EAGER)	Rennie Kaunda, Elizabeth Holley, Priscilla Nelson	National Science Foundation	\$300,000	8/1/2015-7/31/2017
Advanced Mine Rescue Skills Training Using Multiple Training Modalities	Robert Ferriter	MSHA	\$224,006	9/30/2015-9/29/2016
Coal Safety and Performance	Jürgen Brune, John Grubb and Ian Lange (E&B)	Earth Resources Institute (ERI)	\$25,000	TBD
Policy Alternatives for Capturing Vented and Fugitive Methane Emissions Associated with Fossil Fuel Extraction in the U.S.	Graham Davis (EB) and Mark Hart (MN)	ERI	\$25,000	TBD
Edgar Mines Stress/Fracture Testing	Masami Nakagawa	Sandia National Laboratories	\$132,257	5/27/2015-12/31/2015

Ongoing Faculty Research Projects

Project Title	PI/Co-PIs	Sponsor	Project Dates
Combustion Modeling and Spon Com Prevention in Longwall Gobs	Jürgen Brune, Gregory Bogin, John Grubb	NIOSH	9/1/2014-8/31/2019
New Exploration Model for Sediment-Hosted Gold Deposits in Nevada	Elizabeth Holley	Newmont USA	8/1/2014-7/31/2016
Developing Blast Shield for Avalauncher Used by CDOT During Avalanche Control	Vilem Petr	CO Department of Transportation (CDOT)	9/10/2014-9/1/2016
Sustainable Energy Development Exchange in Indigenous Communities	Masami Nakagawa	US Department of State	9/30/2014-5/31/2017
Tech Transfer Collaboration—Edgar Mine	Masami Nakagawa, Priscilla Nelson, Wei Zhou	NREL	12/23/2014-12/22/2015
Development of a New Rock Dust Sampling Instrument	Jürgen Brune, Gregory Bogin, Masami Nakagawa	Alpha Foundation	11/01/2013—1/31/2016
Development of a New Stochastic Mine Production Scheduling Optimization Algorithm	Kadri Dagdelen	Newmont USA	1/5/2015-2/29/2016
Sequestration of Acid-Generating Mill Concentrates: Cripple Creek	Elizabeth Holley	Cripple Creek and Victor Gold Mining Co	9/1/2014-8/31/2016
Ore Characterization at the Wharf Mine, South Dakota	Elizabeth Holley	Coeur Mining, Inc.	6/1/2015-5/31/2016
Explosive Safety Training with Colorado School of Mines	Vilem Petr	CDOT	6/24/2015-6/23/2020
ANFO Shelf Life Comparison for a Variety of AN Pills and Additives	Vilem Petr	Lubrizol Advance Materials, Inc.	7/1/2011-12/31/2015
Helicopter Avalanche Control Research Agreement	Vilem Petr	CDOT	4/1/2014-7/31/2017

CSM at 2015 SME Conference

Colorado School of Mines was well represented at the Society for Mining, Metallurgy and Exploration (SME) Annual Conference and Expo in February through more than 25 faculty and student presentations. Dr. Priscilla Nelson presented “Educating the Next Generation of Industry Leaders,” during a morning session focused on the opportunities and challenges impacting the industry.

We are extremely proud of how well our department was represented. We had CSM Mining Engineering students, faculty, and alumni combine to present 15 technical papers on research at Mines. Find a listing of these papers on our web site at <http://mining.mines.edu/Mining-Newsletter>.

Publications

Mining Engineering students and faculty have been working on sharing the results of their research. They have published in journals, at conferences and in other venues. Check out the list of publications at <http://mining.mines.edu/Mining-Newsletter>.

Breaking News

The Congressional Subcommittee on Energy and Mineral Resources held a legislative field hearing on the "Mining School Enhancement Act" at Edgar Mine on Dec. 14th. The hearing was in regards to the need for more trained engineers, a need underscored by the recent Gold King spill. The four person sub-committee consisted of House Natural Resources Chairman Rob Bishop (R-Utah), Ed Perlmutter (D-Colorado), Crescent Hardy (R-Nevada), and Doug Lamborn (R-Colorado).

This was the first hearing held underground, and it promises to be talked about for a long time to come. Already stories about the hearing have been featured on [CBS Local News](#), [CNBC](#), the [Durango Herald](#), CO Public Radio, [The Gazette](#) in Colorado Springs, SME's [Mining Engineering](#), and several more news outlets ran portions of the AP article.

Dr. Nelson was thrilled with how well the hearing went. "The technology worked perfectly, and the classroom looked like it never has before... I send special thanks to the Hill staffers, but also more directly to Matt Schreiner, Clinton Dattel, Cark Brackpool (our internet magician) and Bruce Yoshioka. And, of course our students and everyone else Matt hoodwinked into helping out. Dr. Brune was there with his personal support, and Dr. Miller gave a fine testimony. And thanks to everyone that

I didn't mention here. What a day!"

There were about 50 people underground for the hearing, including perhaps 10 people from the press, including AP.

Right: Doug Lamborn and Matt Schreiner, Manager of Edgar Mine.

Above. Back row (l-r): Dr. Hugh Miller; Paul Johnson, CSM President; Crescent Hardy; Doug Lamborn; and Nancy Huffbrock, Brierley and Associates. Front Row (l-r): Leigh Freeman, Leigh Freeman Consulting; Ed Perlmutter; and Rob Bishop.

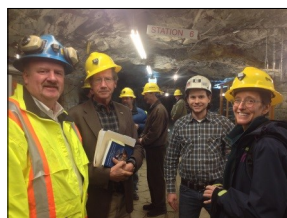


The congressional hearing in the Edgar Mine classroom. Dr. Nelson is center right.



Left: Mines President Paul Johnson speaking with Dr. Miller & Ed Perlmutter after the hearing.

Right: Dr. Miller, Leigh Freeman, Josh Hoffman (Committee Prof. Staff), and Elizabeth Gide of the National Academies.



US-Brazil Connect with CSM

On February 24, 2015, the Mining Engineering department partnered with US-Brazil Connect to host a full-day workshop titled "Mining and Sustainability in Career Awareness." A group of 30 Brazilian high school students watched a video production on the CSM campus and participated in an educational tour of the Edgar Experimental Mine. We have seven Brazilian grad students in the department who acted as their mentors and tour guides around Edgar.

The event was sponsored by the Alcoa Foundation, The Brazilian Confederation of Industry, and the Woodrow Wilson International Center for Scholars. This project builds on the existing US-Brasil Connect partnership with CNI - Confederação Nacional da Indústria, SENA and SESI which jointly created and operate the Conexão Mundo education program. The overall objective of the event was to build career awareness of global opportunities in sustainable mining and the importance of this industry.

The students really enjoyed their time at CSM, as according to the US-Brazil Connect team many of the students listed their time here as their favorite part of the trip. The students even sent handwritten notes to show their appreciation. Here are some of the highlights from the student notes:

"Thanks for confirming my willingness to do engineering." Kevin Ferroz

"It was really surprising to know more about the classroom insides of the mine. We learned how the technology can help get knowledge." Talito Cossango

"Thanks for showing the importance of mining to the whole society!" Nathanael

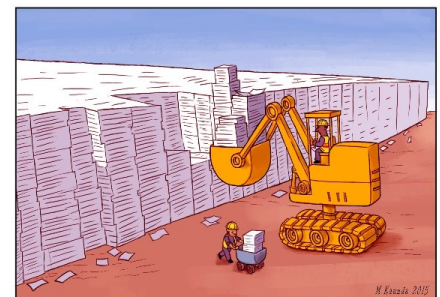
"Thank you for having wifi inside your mine." Ana Paula



Upcoming Events

There will be nine students presenting at the 2016 SME Conference in Arizona.

Check the website for upcoming events and short courses.



CONTRIBUTERS: MN faculty, staff, and students
EDITORS: Rachel McDonald, Rennie Kaunda, Priscilla Nelson