



Mining Engineering's Department News

Department Head Welcome

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Special Interest

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Our Faculty

Priscilla P. Nelson,
Professor and Department
Head

Professors
Kadri Dagdalen
Sebnem Düzgün
M. Ugur Ozbay

Associate Professors
Mark Kuchta
Hugh B. Miller
Masami Nakagawa
Jamal Rostami

Assistant Professors
Elizabeth Holley
Rennie Kaunda
Eunhye Kim
Nicole M. Smith

Greetings! Its that time again, and I get to tell you all about what's been happening on this wonderful campus with its superb faculty, staff and students. To begin— We welcomed two new faculty members to the department – Dr. Nicole Smith, who is an anthropologist, and Dr. Sebnem Düzgün, who is a mining engineer. Dr. Smith started in January as an Assistant Professor, and she comes to us from completing her PhD at U. Colorado Boulder and a post-doc at Mines. Dr. Düzgün started in August, relocating from the Middle Eastern Technical University in Turkey. She is appointed as Professor with tenure and holds the Fred Banfield Distinguished Endowed Chair in Mining Engineering. We also hired a new technical staff member for EMI – Brent Duncan.

The Nazarbayev University project (in Astana, Kazakhstan) got underway in May. Mines is developing graduate course material for a new School of Mining and Geosciences (SMG), and the Mining Engineering degree is first, to be followed by degrees in Petroleum Engineering and Geological Sciences and Engineering. To accomplish this, we hired seven Professors of Practice who are working together with our faculty to develop 12 courses. We are using this opportunity to both renew our own graduate course curriculum and also to develop a NEW degree program – the Professional Master's (PM) degree in Mining Engineering and Management. We plan for the PM degree to be launched on-line with two of the courses prepared in time for the Fall semester, 2018.

Perhaps because of our #1 ranking in the world, during the year we had visits from GERENS in Peru, Leoben in Austria, Universidad Católica and Universidad Adolfo Ibanez in Chile, CUMT (both campuses) in China, U. of Adelaide in Australia, U. Lulea (Sweden), Laurentian University (Canada), a group of Members of Parliament from Mongolia, a minister from Kenya, and a Dept. of State-sponsored delegation from Oman. And we have an internship program starting with CSN in Brazil and discussions about professional education with the Saudi Geological Survey and the Arab Mining Company.

The department's Industry Advisory Committee (IAC) also met twice in 2017. We completed new Memoranda of Understanding (MOU) with Curtin University, GERENS, Hexagon Mining, CUMT, and Caterpillar. We also planned future possibilities with Alight, Anglo Gold Ashanti, BHP, Ernst & Young, Exponent, Jacobs, Jolimont, Martin Marietta, Orica, Putzmeister, RCF, Summit Materials, and Technexus.

We are very active in student recruitment. One major event for this is the **Alumni Reception at SME** – and we will surely be convening once again in Minneapolis in February 2018. Please plan to stop in if you go to that meeting! We also participated in the "Girls Lead the Way" program sponsored by SWE, the "Discover Mines" activities on campus, and we hosted two "CERSE Edgar Days" for more than 150 first year students to visit our wonderful mine in Idaho Springs.

Our faculty are very active in research, and we were part of the Mines' team that received a grant from the U.S. Department of Transportation to establish a Research Center on Underground Transportation Infrastructure (UTI). This award is for \$7.5 million over five years (potentially renewable), and five of our faculty are actively involved in projects. You can read about other research activities elsewhere in this newsletter.

I travelled to New York in January for "The Moles and the UCA Fox Symposium," and attended the "Engineering Solutions for Sustainability: Toward a Circular Economy" symposium before the SME meeting in Denver. I attended two NSF workshops – "Geotechnical Fundamentals for Addressing New World Challenges" and "Geotechnical Women Faculty - Networked and Thriving Workshop," and participated in the "Corporate Social Responsibility in Engineering Education," "Investigating the Technoscientific Worlds of Mining and Subterranean Extraction" and the "Mini-symposium on Robotics" workshops at Mines. I was on the steering committee for the "The Subsurface in the American West" at CU Boulder, the "Imagine" Symposium at George Mason University and the "Sustainable Infrastructure" workshop and symposium at CU Boulder. I am about workshopped out!

I attended the RETC (Rapid Excavation and Tunneling) meeting in June, followed immediately by a trip to Norway for the World Tunnelling Conference. I also attended the July "NAE Grand Challenges" summit in Washington, D.C., the SHRP2 CDOT Showcase, and I travelled to Kazakhstan three times during the year. I served on three National Science Foundation proposal review panels, chaired NIOSH's MSHRAC (Mine Safety and Health Research Advisory Committee), and twice met in Washington as a member of The National Academy's Committee on Geotechnical and Geological Engineering. Finally, we organized the second Orphaned & Abandoned Mine Summit on campus in 2017 with more than 150 people present. In my spare time, I performed as guest entertainer at a "Concert in the Library" on campus – presenting Shakespearean soliloquy take-offs under the title "To Dig or Not to Dig." Great fun!

Our department can only accomplish all of these wonderful things because of your guidance and financial support. We thank you from the bottom of our individual and collective hearts. We invite your input, thoughts, questions and ideas, and we invite you to come visit.

Best regards and best wishes, *Priscilla*



**Dr. H Sebnem Düzgün
Fred Banfield Distinguished
Endowed Chair and
Professor**

Meet the New Faculty

Dr. H. Sebnem Düzgün recently joined the faculty in August 2017. Dr. Düzgün was born in Nazilli, Turkey and graduated second in the class of 1992 from the Department of Mining Engineering at Middle East Technical University (METU), Ankara, Turkey. She received her M.Sc. and Ph.D. Degrees in 1994 and 2000, respectively from the same department. She was a visiting scholar in the Department of Civil and Environmental Engineering at MIT from 1998 to 1999 with an award given by the Turkish Scientific and Technical Council (TUBITAK). She was appointed as assistant professor in Geodetic and Geographic Information Technologies Program at METU in 2001. She performed research as a postdoctoral fellow from 2004 to 2005 at the Norwegian Geotechnical Institute and International Center for Geohazards with a grant from the Norwegian Research Council. She then returned to METU in 2006 as an associate professor and became a full professor in 2010. Dr. Düzgün was awarded the Alexander von Humboldt Foundation's experienced researcher fellowship in 2014 and used it to conduct research at the Geophysical Institute at Karlsruhe Institute of Technology in Germany from 2015 to 2016. She has 17 years of experience in research and teaching in mine closure and reclamation, quantitative sustainability assessment for mining projects, risk and safety analysis for coal mines, mine environmental monitoring using remote sensing, reliability based design and analysis of rock slopes, uncertainty modeling in rock engineering, and interdisciplinary topics including geographic information systems, remote sensing, spatial and spatio-temporal data mining, landslide and earthquake risk assessment, critical infrastructure resilience.

Dr. Düzgün is on the Editorial Board of various scientific journals, namely *Journal of Sustainable Mining*; *Computers and Geosciences*; *International Journal of Emergency Management*; *Georisk Journal*; *Energy Exploration & Exploitation*; and *The Open Construction and Building Technology Journal*. Since 2008, she has served as an expert evaluator and reviewer for the FP7 and Horizon 2020 European Commission's Research and Innovation Programs (including the themes ICT, Secure Societies, Critical Infrastructure and the RFCS-Research Fund for Coal and Steel). Dr. Düzgün has served as a consultant to top level national governmental organizations in Turkey (Turkish Statistical Institute, the Ministry of Culture and Tourism, the Union of Turkish Bar Association, the Grand National Assembly of Turkey, the Ministry of Development and the Ministry of Public Works and Settlement, Ministry of Interior Affairs) and national and international mining industry partners (Turkish Coal Enterprises, Turkish Hard Coal Enterprises, Eti-Maden, STFA Construction Company, and INMET-Cayeli Copper Mine). She is also involved in a large number of international and national research projects funded by the European Commission, NSF-International Collaboration Program, Ministry of Energy, Ministry of Industry, TUBITAK. She is a member of SME, ARMA, ISRM, IEEE and ISPRS.

Dr. Düzgün has authored four books, published 11 book chapters, 60 papers in peer-reviewed scientific journals, over 150 conference articles, and many technical reports, which had over 1380 citations. She is the principal author of the book titled "Remote Sensing of the Mine Environment". Dr. Düzgün also supervised 18 PhD and 35 MS theses. Dr. Düzgün's recent research areas involve quantitative risk and resilience assessment for mining hazards and geohazards, big data analytics, Earth observation in geosciences, virtual/augmented/mixed reality (VR/AR/MR) and serious gaming for technical training and collaborative decision making. Dr. Düzgün is currently establishing a collaborative immersive VR/AR/MR laboratory at Mines. She was founder and former CEO of the software company Kuzgun Informatics, in Turkey, contributor to three ceramic art exhibitions, the drummer of a local Turkish band, and is a mother to two sons.

Research and Adjunct Faculty

Carl Brackpool, Research Associate
Larry Clark, Research Associate
Conrad Felice, Research Professor
Richard Gilmore, Research Assistant Professor
Mark Hart, Adjunct Professor
Paul Jones, Adjunct Professor
John Lipka, Research Associate
Vilem Petr, Research Associate Professor
Matt Morris, Adjunct Professor
Erik Spiller, Adjunct Professor
Karl Zipf, Research Professor

Professors of Practice

Jurgen Brune, Professor of Practice
Barbara Filas, Professor of Practice
John Grubb, Professor of Practice
Robert Reeves, Professor of Practice
Dermot Ross-Brown, Professor of Practice
Andrew Schissler, Professor of Practice
Dirk Van Zyl, Professor of Practice
William Wilson, Professor of Practice

EMCIS Staff

Robert Ferriter, Mine Health & Safety Specialist
Katherine Harman, Staff Engineer
Clancy Harman, Research Associate
Kirk McDaniel, Director of Program Development
Michelle Reiher, Manager of Training
Collin Smith, Director of Operations
Korky Vault, Registration Coordinator

Mining Engineering Staff

Emilia Clayton, Research Support
Clinton Dattel, Edgar Mine Superintendent
Brent Duncan, EMI Manager
Ray Johnson, ERL Lab Manager, AXPRO & EMI
Justine Robinson, Program Assistant
Matt Schreiner, Edgar Mine Manager
Bruce Yoshioka, Lab Coordinator



Meet the New Faculty

For many of you, I am a new face in the Mining Engineering Department. I was hired as an assistant professor in January of this year. I am thrilled to be part of this team and look forward to working with my colleagues in new and innovative ways. Prior to joining the Mining Engineering Department, I was a post-doctoral scholar for two years in the Humanitarian Engineering Program at Mines and before that, I held a post-doctoral fellowship at the Centre for Social Responsibility in Mining (CSRSM) at the Sustainable Minerals Institute at the University of Queensland, Australia. I now am an Honorary Research Fellow at CSRSM, and this year, was awarded an Academic Associate fellowship from Newmont Mining.

Dr. Nicole Smith
Assistant Professor

I am a cultural anthropologist and completed my PhD work at the University of Colorado at Boulder (CU). While at CU, I also obtained a certificate in Development Studies. My research and teaching interests are in artisanal and small-scale mining; mining and social responsibility; rural livelihoods and sustainable development; indigenous peoples; and engineering education. My dissertation project took place in northern Tanzania with Maasai gemstone (tanzanite) traders, where I examined their involvement in the tanzanite commodity chain and the impacts of this on Maasai households and communities. I currently am working on three funded projects (two funded by the US Department of State and one funded by NSF) in Latin America focused on artisanal and small-scale mining (ASM). As many of you know, ASM is an important livelihood strategy for millions in the developing world, but also poses many serious environmental, health, and safety risks for individuals and communities, as well as large-scale mining operations. My research addresses these challenges by collecting and analyzing qualitative and quantitative data on both the social and technical context of ASM communities and operations. I have implemented this research into classrooms at Mines by working with my colleagues to educate engineering students to co-design, implement, and evaluate sustainable and culturally appropriate technologies and practices with artisanal and small-scale miners and affected communities. This past summer, I conducted field research in Peru in a small-scale mining community. I traveled to the field with a Mines student and engineering students from our partnering university in Lima, Peru, UTEC (see photo).

This fall semester, I taught a new graduate course titled Energy, Natural Resources, and Society, and I am currently developing two new courses for Spring semester: an undergraduate course titled, Communities and Natural Resource Development, and a graduate course titled, Sustainable Development and Mineral and Energy Resources. This course will apply an innovative teaching methodology via video-conferencing that links together faculty members and graduate students from Virginia Tech and the National University in Medellin, Colombia. I am very excited for this opportunity to bring together scholars and students across geographic, cultural, and disciplinary boundaries to discuss sustainability and earth resource development. I look forward to contributing to the holistic training of our industry leaders of tomorrow and welcome any ideas for collaboration with our esteemed alumni, industry partners, and mining engineering advocates.



Photo caption: Students from Mines and UTEC and NGO representatives from the Alliance for Responsible Mining (ARM) in Colombia learn about ASM ore processing systems in Peru. Photo taken by Nicole Smith.

Please contribute to a research project by completing a very short online survey. The survey is part of a larger project led by Dr. Sebnem Düzgün and Dr. Nicole Smith on "Sustainability and Earth Resource Industries". The project aims to understand current perceptions of and practices related to sustainability in earth resource industries.

Survey Link: <https://www.surveymonkey.com/r/minessustainability>

Faculty Perspectives



Dr. Jamal Rostami, Alacer Gold/Haddon Endowed Chair, Associate Professor

Hello Alumni. This year has been busy and rewarding. Offering courses as part of the MN and UCT programs on tunneling has been the core of my teaching efforts. Meanwhile, the main focal point of my work has been growing the EMI's research activities and upgrading the equipment. I attended several national and international conferences, often presenting papers and expanding our network of collaborations with our peers across the US and internationally. This includes the world tunneling congress in Norway and the international conference in ground control in mining in China, as well as RETC conference in California and the ground control conference in West Virginia. I visited Atlas Copco in Sweden, the CAT underground rock cutting group in Germany, and Xuzhou, China, as part of the collaborations between CSM and the China University of Mining Technology. On another front, it was absolutely delightful to hear the selection of our proposal on drilling on the moon and mars by the Early Stage Innovation (ESI) program of NASA that was announced in October. On the publication front, there are already three peer reviewed journal papers that have been published, while an article on TBM design has been accepted for publication by the

Chinese Academy of Engineering. Five other papers have already been reviewed and are ready for final proof reading and publication. I have been preparing and organizing for the upcoming ABET visit in 2018, and I might reach out to our industrial advisory board, recent alumni, and companies who are hiring our graduates for their feedback. I would appreciate your support by filling out the surveys as you receive them.



Dr. Hugh Miller, Associate Professor

As compared with most summers, this year was exceptionally busy. I had the opportunity to work on a wide variety of educational and research activities that spanned department educational initiatives to advancing the research agendas associated with our current projects in hydro-excavation and occupational safety and health. With 6 Ph.D. students working on a range of thesis topics, including supply chain management, truck autonomy, mineral comminution, and metal cutting in explosive environments, it never gets boring. As you might expect, working with students is the best part of this job. In May, we began a research project associated with new technologies in the selective removal and repair of shotcrete tunnel liners as part of the University Transportation Center for Underground Transportation Infrastructure (UTC-UTI) Grant we received last year. The Energy, Mining and Construction Industry Safety (EMCIS) Program is continuing to do well as a comprehensive training resource for the mining industry, which is devoted to reducing workplace injuries and illnesses, particularly among underserved groups like small mines, contractors, consultants, suppliers, and manufacturers. Significant effort is being made to expand the breadth of EMCIS training activities to include greater collaboration with other industry sectors, as well as government entities.

In August, we were awarded a 3-year, \$1.45 Million grant by CDC NIOSH to continue these important activities. One of the major time commitments I've had this summer has been towards trying to complete a textbook with Bill and Andrew Hustrulid on the Fundamentals of Mining. This has become a lot more work than I initially anticipated. I have also been involved in developing curriculum and training materials for several international capacity building activities, and I have engaged in professional service through the Society for Mining, Metallurgy & Exploration (SME) and the Waterjet Technology Association (WJTA). This is a brief synopsis of my activities for the last few months. If you find yourself near Golden, please let us know. I would love to have you stop by and see what we're doing.



Dr. Masami Nakagawa, Associate Professor

There are several updates that I would like to share with you. In March, my Fulbright assignment officially concluded with the formation of a Multi-Institution Bolivian Geoscience Team consisting of five professors, a state geologist and two graduate students. Our first official field work activity included looking for geothermal resources in the state of Tarija, Bolivia. Unexpectedly, we had a warm welcome by the representatives of a small town Timboy, and we all felt appreciated for what we do for the community. Phase one of the "GeoPark" project funded by the Navajo Energy Transition Company concluded, and we submitted a proposal to the Division of Energy & Mineral Development (DEMD) for phase two funding. In October, we started a new project (\$372,000 funded by the MHA Nation - Department of Interior: Paulo Tabares-Velasco (Lead PI), Ian Lange (PI), Masami Nakagawa (PI)) to conduct a feasibility study for renewable energy at Fort Berthold Indian Reservation in North Dakota. I am looking at geothermal potential on the reservation. I had my first trip to Spain as an invited keynote speaker and delivered a lecture entitled "Human Aspects of Project Management: Theory and Practice of Agent Based Modeling of Decision Making Process" at the 21st International Congress on Project Management and Engineering, Cadiz, Spain on July 14. Two of

my PhD students have graduated since last reporting, and two more will be graduating in spring 2018.



Dr. -Ing. Jürgen Brune, Professor of Practice

On behalf of Mines, I organized and hosted the 16th North American Mine Ventilation Symposium on the Mines Campus in June. This Symposium is held every two years and attracted 227 delegates from 17 countries. Researchers presented 75 peer-reviewed papers organized in 20 sessions, and 107 attendees participated in 6 short courses held in conjunction with the symposium. I was elected to be the United States representative in the International Mine Ventilation Committee, a Committee that selects the host for the International Mine Ventilation Congress every 4 years. This Congress provides an international forum for the exchange of information encompassing the broad spectrum of activities associated with mine ventilation and environmental engineering. The 12th IMVC will be held in Xi'an, China, September 14-18, 2018. Continuing our leadership from Mines, I am preparing a bid to host the 13th IMVC at Mines in 2022.

Publications

2017 has been a prolific year for Mining Engineering. For a list of faculty and student publications for 2017 please go to <https://mining.mines.edu/recent-publications/>

Faculty Perspectives



Dr. Rennie Kaunda, Assistant Professor

Hello Alumni and Friends of Mining Engineering. It's been yet another busy and productive year! During spring 2017 I taught Introduction to Mining with Hugh Miller. I also taught Rock Slope Engineering and the students enjoyed the field trips. February was the SME annual conference where I serve on a couple committees. My student Shrey Arora presented a paper at SME titled "A scientific approach for predicting the penetration rate for an earth pressure balance machine." In June, I travelled to Norway for the World Tunneling Congress. During the same month, I visited research colleagues in Bochum, Germany and Leoben, Austria. As a result, I was unable to attend ARMA in San Francisco this year, but my student Fei Wang went and presented a paper titled "Artificial neural network modeling of contact electrical resistance profiles for detection of rock wall joint behavior." In July, I was part of the international organizing committee for the Mining and Geology of sub-Saharan Africa conference in Livingstone, Zambia. I chaired a couple sessions at this well-attended conference (~200 international audience) and also presented a paper by my student Alex and I titled "Advances in open pit slope design." In Fall 2017, I'm teaching Introduction to Mining, and Mining and the Environment. In addition to my classes, professional service and research responsibilities, I continue mentoring several undergraduate and graduate students. Please feel free to stay in touch through email or other means. So until next year – best wishes to all!



Dr. Eunhye Kim, Assistant Professor

Dear all, I've taught my new course, "Fracture Mechanics of Brittle Materials," which deals with basis and applications of fracture mechanics in geomaterials and brittle materials. This class is an important part of my work because not only is this topic my current research area, but also I employed various teaching techniques to enhance students' meta-cognition, data analysis, interpretation, and presentation skills of each student. After the class, the students seem to have deep understandings of rock fracture mechanics and clear directions of their research. I would like to acknowledge the people who provided me an opportunity to take the summer intensive workshop at Mines this year. From this workshop, I got a deep understanding of pedagogical, social science and humanity aspects of education which I truly appreciated! In addition, I had a productive summer as I launched my rock mechanics database website, www.emirock.mines.edu, with my student Ryan, successfully organized and led the Abrasivity and Wear Lab at the Tunneling Short Course with my two PhD students Varun Maruvanchery and Hui Lu, and served on the international scientific committee for the "2017 International Conference on Tunnels and Underground Spaces" in South Korea. I also helped organize one session at the inaugural symposium of the University Transportation Center for Underground Transportation Infrastructure. Tune in for more exciting stories!



Dr. Elizabeth Holley, Assistant Professor

This year I reinvented my graduate Mining Geology course to challenge the students with a new theme: *how does geologic uncertainty propagate from the geologic model to the block model, and what are the implications for mining?* We approached this question through extensive reading, team-led discussions, and a semester-long 3D modeling exercise. Through the support of CSM alumnus, a mining company donated an enormous dataset from an undisclosed location so that the students could investigate the impacts of geologic uncertainty using data from an actual mining project. Leapfrog 3D facilitated the hands-on exercise by loaning us student licenses for their implicit modeling software. The students constructed numerous 3D geological models from the company dataset and tested how various assumptions changed the final block model. In their final papers, the graduate students concluded that even seemingly small decisions about the spatial extent or grouping of lithologies, alteration styles, or structural trends manifested as large changes in their block models. It is my hope that the students will carry this practical experience forward in their careers and approach modeling with caution and the awareness that, as the old axiom reminds us, "all models are wrong but some are useful." Graduate student Mustafa Tokoglu, took the Mining Geology course last semester and reported

"Considering potential influence of risk and uncertainties associated with geological attributes on downstream mining practices, sound understanding of geology is fundamental in modeling practice. I found Mining Geology an effective course that involved in-depth discussions about numerous unknowns and assumptions involved in a typical geological modeling routine and how they might propagate to have material impacts on subsequent steps. Furthermore, it was great to have the opportunity to work on a real dataset generously provided by the company to address the following research questions: (i) how do we get from the geological model to block model, (ii) what are the assumptions of both models & how are they communicated (iii) how do the unknowns in the geological model impact the block model. Finally, the active learning environment encouraged by Dr. Holley is what makes Mining Geology an invaluable course."



Dr. Vilem Petr, Associate Research Professor

Greetings Alumni and friends. This year, I'm teaching Engineering Design 151, in addition to my research duties. This new undergraduate project design course gives students the opportunity to learn about explosives technologies. In Spring 2018, I will teach Engineering Design 251, where students will work on industry-sponsored research projects related to avalanche control, oil and gas, and slope stabilization. In March 2017, we published the peer-reviewed article "Characterizing the energy output generated by a standard electric detonator using shadowgraph imaging" in the journal *Shock Waves* (<https://link.springer.com/article/10.1007/s00193-017-0718-8>). Eduardo Lozano successfully concluded his first year in the Ph.D. program in the Mechanical Engineering Department at the Colorado School of Mines. In this third semester, he will be taking the Thermal Sciences Ph.D. Qualifying Exam, which intends to evaluate whether the candidate has mastered the core subject matter in the thermal sciences discipline. Erika Nieczkoski is graduating with her undergraduate degree in Mining Engineering December 2017. She is currently considering pursuing an MS degree, in the subject of energetic materials and is looking forward to opportunities in the future after graduation. Christian Peterson is a senior undergraduate student majoring in Mechanical Engineering, who started working for AXPRO in Summer 2017. As an undergraduate research assistant, Christian had the opportunity to assist in conducting PETS training, work with CDOT, and conduct explosives research this summer. Christian was awarded the Orica USA Scholarship, a scholarship for undergraduate students who are interested in mining or explosives engineering. I look forward to hearing from you, and please stay in touch!

Student Activities

CSM Mine Rescue Team Activities

The Mines Student Mine Rescue Team has had an exciting year. February 16th to February 18th, the team hosted an International Collegiate Mine Emergency Response Demonstration (MERD) at Mines. Mines organized the event and invited student teams from South Dakota, Montana Tech, University of British Columbia and Laurentian University in Canada, and the Technical University of Bergakademie Freiberg in Germany to participate in an international mine rescue contest on campus and at the Edgar Mine. The six student mine rescue teams competed in realistic underground mine emergency and rescue scenarios that included exploring the Edgar Mine wearing mine rescue breathing apparatus under smoke and rescuing injured miners, a first aid contest and a bench technician contest. The contest was supervised and judged by members of mine rescue professionals from Newmont Mining and Barrick Gold Corporation. The CSM White Team won 1st place in the Technician Contest. The CSM Mine Rescue Team also competed at the Nevada Regional Mine Rescue contest in March where they competed against corporate mine rescue teams from several Nevada mining companies. The contest was judged by the federal Mine Safety and Health Administration.

In April, five members of CSM Mine Rescue Blue Team went to Pennsylvania to visit the Matterhorn Mining Boots Factory in Martinsburgh, PA. Each team member had the opportunity to custom-build a pair of mining boots for themselves.



CSM SME Student Chapter Activities

The SME BBQ is always a huge hit as it provides a great atmosphere for new members and existing members to network. This year, the Earth Mechanics Institute hosted us (THANKS!). At the event, some food was catered by a member's family, and some was cooked by members. There were around 100 people in attendance with a good mixture of professors, undergrads, and grad students. On September 8th, 2017, five members of the SME Chapter joined the SME CO Section for their annual golf tournament at Fossil Trace Golf Club in Golden, CO. The members helped with registration and collected over \$1000 for the SME CO Section scholarship fund by selling mulligans to the golfers. Three members were fortu-



nate enough to play with the teams from Resource Capital Funds (RCF) and one of the members nearly earned the longest drive on hole #6. On the course, the hole sponsors were a joy to network with, and many by offering their expertise during a Chapter meeting presentation. On Friday August 18th, the CSM section of SME joined the M-Climb for the class of 2021 and had a booth on the way up to the M. A rite of passage for freshman, the significance of the event unites students and alumni across every discipline from CSM. CAT generously supplied us with a banner and t-shirts, and we made new CSM students aware of SME as a club and raised awareness of Mining, Metallurgy, and Exploration Geology. We brought a large tub of water, water guns and candy. When each group of students made it up to our station, we helped lead the CSM fight song and subsequently threw a barrage of water and candy at them, all the while having fun and brandishing our banners. The event was successful as we signed up over 40 freshmen to our email list.

Cripple Creek Victor Mine Field Trip

25 students from Dr. Kadri Dagdelen's Surface Mine Design class visited Newmont's Cripple Creek and Victor Gold Mine in Colorado on October 12, 2017. The students indicated they had a great time and learned a lot during the visit. A big thank you to **Newmont** for making this visit possible for our undergraduate students.

And for other partners and alumni, if you and/or your company can offer us additional mine site visit opportunities, let us know!!!!



Student Activities

CSM International Mining Competition Team Activities

Each year the Mining Games Competition team travels to the Intercollegiate International Mining Competition. This year, the 40th International Collegiate Mining Competition will take place in March 2018 in Camborne, England. In the past, students have traveled to Australia, Missouri, Kentucky, Nevada and more—CSM even hosted the event in 2013. Additionally, the games keep alive traditional mining events that are part of our industry's legacy. Mining schools from all over the world alternate hosting the games each year, which has helped the event grow in popularity and attract an ever-growing group of international competitors. Colorado School of Mines has participated in the games for the last 39 years and increased participation and a competitive spirit has produced a world-class team. At the 2017 Kentucky games, the CSM Co-ed team took 3rd place in Swede Saw, 2nd place in Gold Pan and 1st place in Jack Leg. There are seven events that the Mining Competition Team competes in: Hand Mucking, Hand Steeling, Swede Sawing, Gold Panning, Track Standing, Jackleg Drilling and Survey.



Caterpillar Student Leadership Experience Program—October 15-18, 2017

Through the generosity of Caterpillar's Surface Mining & Technology Division, four students from the SME Student Chapter Executive Committee participated in a student leadership training experience at CAT's Tinaja Hills Demonstration Center in Green Valley, Arizona. Designed specifically for our Mines' students, this unique training program exposed students to an understanding of the value of a servant leadership approach and the ability to leverage their own individual strengths to motivate and lead others. Led by some of Cat's top Managers and Executives, the program included a Strength Finders assessment, a panel discussion on career experiences and lessons learned, skill building presentations on leadership styles, organizational climates, and building effective teams, a tour of CAT's Tucson Proving Grounds, and an incredible opportunity to operate equipment at the Tinaja Hills training facility. Both the students (Evan McCombs, Roland Daniels, Tyler Rockley, Kinsley Costner) and their faculty advisor (Hugh Miller) had a fantastic time. The students and our department extend our sincere thanks to Jean Savage (Division Vice-President), Ben Cordani (Director-Human Resources), Theresa Strong (Mining Capabilities Manager), Chelsea Pomeroy (Marketing Representative), and their many Caterpillar colleagues for making this tremendous learning experience possible.

Reducing Mercury

Funded by a grant from the Environmental Protection Agency (EPA), a team of CSM students have worked for the past year on a technological intervention to reduce the use of mercury in small-scale gold mining and in May presented their prototype at the EPA P3 Symposium in Washington D.C. The team was advised by mining PhD student Benjamin Teschner (Co-PI) and Mining Engineering Assistant Professor Nicole Smith (Co-PI). The team focused their project on a gold mining site in Suriname.



Mining Engineering Senior Design Team Tours Summit Materials Boxley Fieldale Aggregate Quarry in Virginia

The Summit Materials Senior Design team of Bill Behre, Mike Reyes-Silvis and Myles Brandt with Mining Engineering faculty Bill Wilson and Masami Nakagawa visited the Boxley Fieldale Aggregate Quarry in Martinsville, Virginia on October 10th. Brent Ward, Vice President of Aggregates for Summit Materials was the tour host. The team's project is to evaluate the proposed operational changes at Fieldale related to the quarry and processing facility. As part of the tour, the operations team at Fieldale briefed the team on geology, operations, markets, project dynamics and permit revision requirements. Summit sells aggregates from the Fieldale quarry in southern Virginia and northern North Carolina. The team will complete their Pre-feasibility Study in the Spring of 2018 Semester.

Scholarships & Fellowships

We continue to support our students through scholarships and fellowships. We are thankful for the generous contributions from our partners that make these awards possible. The following scholarships were awarded:

Agapito, Atlas Copco/Fronapfel, Barrick Gold, Bowie, Cooper-Hansen, C. Pillar, Ensign Bickford, Grosvenor, Goldcorp, Harris, Johns Family, Martin Marietta, McCormack, McQuiston Fellowship, Milton, Mulryan, Murchison, Newmont, Pegasus Gold, Provost, Summit Materials, Ward

Department Updates

EDGAR MINE

Operations at the Edgar Experimental Mine continue to be very busy. The days are filled with preparations for classes, classes, clean-up after classes, rescue training, research and the occasional tour. During 2017, a total of 22 students completed the MNGN 309 Mining Laboratory and over 100 Petroleum Engineering students were introduced to drilling technology and core drilling using a Sandvik 130 drill rig donated by the Apache Corporation. Mechanical engineering students tested their first autonomous robot underground. Several other classes continue to use the Edgar facilities for ventilation, rock mapping, surveying, and other educational opportunities.

Both the Mines' EMCIS program and the State of Colorado's Division of Mining Reclamation and Safety had a productive year with mine rescue training and public outreach tours. Miners from over eight different states participated in rescue training events at Edgar this past summer. Both of our home teams (Henderson Mine and Front Range Mine Rescue) participated in the State of Colorado Mine Rescue Contest and performed well. Henderson Mine Rescue went home with two trophies. Multiple different youth programs were given mine tours led by DRMS employees where they could explain the opportunities available and the benefits of a career in the earth resources industry. The International Student Mine Emergency Response Demonstration (MIRD) was held at the Edgar Mine in February with visiting teams from Canada (2), Germany and the U.S.

The research program at Edgar continues to grow, with several resident projects and some visiting projects from Mines and other institutions. An \$8 million MINES wide proposal was submitted to the Department of Energy to construct and operate a drilling fluid flow loop and laboratory using the Edgar as the base of operations. Several companies came by to demo equipment for faculty and students as well.



And a Swiss drone manufacturer demonstrated equipment capabilities by flying underground and through several of the raises at the Edgar mine. Mining Engineering is conducting two NIOSH-sponsored research projects at Edgar. One involves testing the propagation of methane-air explosions through rock rubble and the other, testing the dispersibility of stone dust under mine explosion conditions. Finely dispersed stone dust can stop coal dust explosions in mines.

In October, the College (CERSE) held two recruiting events at the Edgar mine with demonstrations and presentations by each CERSE department. Over 200 prospective Mining students and their parents attended these CERSE EDGAR Days.

EARTH MECHANICS INSTITUTE (EMI)

The new EMI laboratory manager, Brent Duncan started in April 2017, and Brian Asbury has continued to support EMI efforts as a part time consultant. We have developed new equipment and test manuals to improve safety and enhance the quality of work as part of our continued efforts to offer the highest quality testing in our rock mechanics and rock excavation laboratories. We have also completed a comprehensive laboratory safety audit.

The volume of rock mechanics testing to serve mining and tunneling industries has grown. We have been working on some specialized testing of new bearings for a Korean manufacturer. The new bearings are proposed for use on 19 inch disc cutters that are installed on TBMs and used in industry by many contractors. In these tests we are loading the bearing up to 70 tons of thrust and 10 tons of side load while monitoring the vibration, loading, temperature, rotation speed and torque to detect the deterioration point. Also, EMI has conducted some full scale cutting tests for Hecla Mining Co. as part of their efforts to adopt a new, fully mechanized system for underhand stopping in Lucky Friday Silver mine in Idaho. The new system will include mechanical rock excavation at the face and a fully automated ground support installation, haulage system, and stopping operation to eliminate the need for mine workers to work in the stope and therefore eliminate the possibility of accidents due to rock burst. This is a part of a larger plan for the development of new parts of the orebody at higher depth, where the face is prone to frequent rock burst that could inflict harm to personnel and equipment. This could be a prelude to revolutionizing underground hard rock mining, especially for steeply dipping vein mining operations.

In addition, some full scale rock cutting tests have been performed on hard/abrasive rock samples using disc cutter for Atlas Copco to assist their design team in the development of the new generation of mechanized reef miners. Large samples of rock have also been received from the Boons Dam project in Tennessee to evaluate the efficiency of a hydrophraise system. The objective is to slurry cut-off walls in dam foundation and to key these walls into hard rock formations in the dam abatements. The testing will convene in late Fall 2017 and continue into early 2018. New faces at EMI include Post Doc Omid Frough, who is handling the rock mechanics tests and Wenpeng (Frank) Liu, who is working on rock characterization while drilling. Muthu Thyagarajan, who is finishing his MSc degree in Fall 2017 will start his PhD program in Spring 2018. Wei Hu is a PhD student working on wear issues on mining and tunneling machines and is developing a new testing method for evaluating the abrasivity of rock cuttings and soil. Anuradha Khetwal is a PhD student working on discrete event simulation of mechanical excavators, in particular TBMs, and Reece Kurre is a MSc student working on the improvement of cutting systems on hydrophrases in rock formations.



EMI staff in front of EMI full scale rock boring unit

Department Updates

ENERGY, MINING AND CONSTRUCTION INDUSTRY SAFETY (EMCIS)



The Mining Engineering Department is excited that it has received a 3-year, \$1.445 Million grant from CDC NIOSH Mining in support of its continuing efforts to enhance the quality and availability of health and safety training for Western mine workers. The grant PI is Hugh Miller and the Co-PI is Michelle Reiher. The work will be completed through the Mining Engineering Department's Energy, Mining, and Construction Industry Safety Program (EMCIS). Beginning September 1, the primary goals of the grant include providing workers with relevant knowledge regarding the hazards associated with working at mine sites and effective controls for reducing risk for injuries and illnesses. As part of this effort, a comprehensive approach to meeting the safety and health training needs of the Western mining industry will be employed by providing a high quality, interactive training experience that targets several audiences, including: mine workers, trainers, safety and health professionals, mine management, and mining engineering and geology students. In addition, this training program is designed to service underrepresented industry sectors such as contractors, consultants, suppliers and equipment manufacturers. This approach strongly encourages trainees to become active participants and take ownership in improving the health and safety conditions where they work. If you have any questions or would like to learn more about the program, please contact either Hugh Miller or Michelle Reiher.

ADVANCED EXPLOSIVES PROCESSING RESEARCH GROUP (AXPRO)



The Advanced Explosive Processing Research Group (AXPRO) is advancing its research and interdisciplinary education activities at the Colorado School of Mines and is very excited to be continuing education and training into avalanche control and researching explosive rock-cut methods for the Colorado Department of Transportation (CDOT). We are also introducing a new professional post-graduate program: The Materials Science of Energetic (Explosives) Materials Program.

The AXPRO team continues to teach a state-certified explosives training program, Practical Explosives Training School (PETS) for industry workers, professionals, and explosive handlers who are looking to obtain or renew their explosives permit. This two-day course is a collaboration with the Colorado Department of Labor and Employment (CDLE) and is available yearly in both February and November. The class is taught by Dr. Vilem Petr (Associate Research Professor at Mines and Director of AXPRO) and Scott Narreau (the Program Manager for CDLE Explosives Regulations). Each year, AXPRO has approximately 25 students take this course, and the program continues to grow. For more information about this program and registration questions, please visit our website: www.axpro.mines.edu. During spring 2017, AXPRO continued its partnership with the Missouri University of Science and Technology (MS&T). Dr. Paul Worsley, a professor at MS&T, offered a long-distance learning course on high-speed imaging methods used in explosives engineering. Graduate students from MS&T visited the Colorado School of Mines to gain practical knowledge and experience by working with Ametek Vision Research cameras.

AXPRO is offering two annual courses on experimental techniques in explosives engineering: High-Speed Imaging Methods for Research and Experimentation (HIS) and Flash X-Ray and Ultra High-Speed Imaging Methods for Research and Experimentation (XUHIS). Ultra High-Speed Imaging Methods Research and Experimentation is a four-day course that will be taught in March 2018. This course will teach students ultra-high velocity impact and experimental techniques for capturing detonations, ballistic and impact theory, metallurgical observation and energy partitioning, engineering considerations in hyper-velocity, and how to effectively implement flash x-rays and stereoscopy. Students will gain knowledge and experience through laboratory demonstrations, industry guest lectures, and practical exercises.

AXPRO will be conducting multiple research projects in the upcoming academic year:

1. Improving blasting operations for Summit Materials, LLC. (Sponsor: Lubrizol)
2. Analysis and Optimization of the Use of O'BellX® Avalanche Control System. (Sponsor: CDOT)
3. Pressure Wave Characterization for Industry Cleaning using Bang&Clean® Technology. (Sponsor: EPRI)
4. Electroplated 3D-printed polymer composite structures for use on missile structures (Sponsor: Special Aerospace Services, LLC)
5. AXPRO Compact Explosive Landmine Clearance System (CELCS) (Sponsor: NOC-DOTC)

The AXPRO team attended two international meetings during the past academic year: the International Snow Science Workshop (ISSW) in Breckenridge, Colorado; and the 43rd Annual Conference on Explosives and Blasting Technique in Orlando, Florida. During both meetings, the research team presented the past work done for CDOT that also constituted Eduardo Lozano's Master Thesis: "Design and Analysis of a Personnel Blast Shield for Different Explosives Applications". In the upcoming year, AXPRO plans to participate in at least three meetings including: the 43rd Annual Conference on Explosives and Blasting Technique in San Antonio, Texas; the 43rd International Pyrotechnics Society Seminar in Fort Collins, Colorado; and the 16th International Detonation Symposium in Cambridge, Maryland.

INTERNSHIPS

Our undergraduate and graduate students participate in internships all over the US and the world including USGS at the National Earthquake Information Center, North Antelope Rochelle Mine, Lehigh Hanson, Navajo Mine, Aggregates Performance Team, SRK Consulting and Newmont Mining Corp. If you have internship opportunities for our students, let us know!!!!!!!

Photo taken at the Navajo Mine, North American Coal in Colorado.



Department Updates, cont.



APCOM

The 38th International Symposium on Applications of Computers and Operations Research (APCOM) convened at the Colorado School of Mines between August 9 and 11, 2017. APCOM was founded in 1961 by Stanford, Arizona, Penn State and Colorado School of Mines to promote the application of computer and operations research in the minerals industry.

The 2017 meeting was chaired by Dr. Kadri Dagdelen and was attended by approximately 150 people from more than 15 countries. The APCOM 2017 covered all the new and upcoming topics in many areas in mining including uncertainty characterization in resource and reserve estimation, mine planning and stochastic optimization, internet of things (IoT), dealing with Big Data in mining, geo-metallurgy, mine automation and robotics for mining applications, and economics and finance. In addition, the APCOM Council presented Dr. Thys Johnson with a gold metal for his life long contributions to APCOM. In addition, Ady Van Dunem and Canberk Aras from the Mining Engineering Department at CSM were awarded the Prof. Krige Scholarship.

Congratulations to both Ady and Canberk for receiving this prestigious award.

Congratulations on your retirement Bob Ferriter!

Robert Ferriter retired from the Colorado School of Mines after 18 years of service. Mr. Ferriter has held multiple positions in service to the United States mining industry over a career that spanned 46 years. Mr. Ferriter served with the U.S. Department of Labor Mine Safety and Health Administration Denver Safety and Health Technology Center as both an Engineer and Chief from 1971 to 1997 addressing many issues related to health, safety and technology. In 1999, Mr. Ferriter identified an industry need and was instrumental in developing the Mine Safety and Health Program (MSHP) at the Colorado School of Mines. The MSHP and its successor, the Energy Mining & Construction Industry Safety Program, develops training courses and presents programs on mine



safety and health. Special programs and routine course offerings cover a variety of subjects including mine haulage, ventilation, blasting, ground control, electrical safety, dust and noise abatement, radiation, and loss control. Additionally, Mr. Ferriter was instrumental in developing mine rescue training at Colorado School of Mines.

Mine Abandoned Mines Summit



In 2016, Colorado School of Mines hosted its first summit focused on the environmental impacts of mine closure and remediation strategies, bringing together non-governmental organizations, researchers, industry representative and other stakeholders. "Reasonable Expectations for Mine Closure" highlighted the need to continue the conversation and develop collaborative strategies that lead to action. A second summit, "A Framework to Manage the Environmental Reality of Orphaned and Abandoned Mine Lands" convened on November 14, 2017 on the Mines campus.

Panel participants and speakers shared ideas on best practices for navigating the complex environmental, political and social aspects of managing orphaned and abandoned mine lands, generating expectations for future stakeholders.

The Payne Institute for Earth Resources sponsored the summit, in collaboration with the Department of Mining Engineering, the Engineering, Design and Society Division, the Department of Civil and Environmental Engineering, and the Keystone Policy Center. Discussions ranged from technical aspects of successful mine closure, looking at both good and bad examples of mine remediation, to partnerships and policy in the sociopolitical arena.

The series of Mines' Summits brings stakeholders together to collaborate and develop ideas on how to effectively resolve mining industry issues, understanding potential technical limitations as well as identify opportunities for innovation and reuse. The Summit brought together over 150 individuals representing government, industry, consulting, communities, tribes, NGOs and academia to share and identify opportunities. The university plans to host a third summit in 2018 to continue the discussion and generate tangible actions to build on and expedite remediation of abandoned mines.



Congratulations to our PhD students who successfully defended their dissertations this year! We congratulate Kamran Jahan Bahksh, Samuel Atta Lolon and Kirk Haley McDaniel.

New Research Grants Awarded to Faculty

NEWS RELEASE

Assistant Professors in Mining Engineering, Nicole Smith and Elizabeth Holley are Co-PIs on a new \$4 million National Science Foundation (NSF) grant through the Partnerships in International Research and Education (PIRE) program for research on:

Sustainable Communities and Gold Supply Chains: Integrating Responsible Engineering & Local Knowledge to Design, Implement, and Evaluate Sustainable Artisanal Mining in Latin America

This project brings together cutting edge engineering, physical science, and social science scholarship, community-capacity building, and education to tackle one of the world's biggest socio-environmental challenges: making artisanal and small scale gold mining (ASGM) more sustainable for miners, affected communities, and global gold consumers. ASGM systems are simultaneously social, technical, and ecological, involving miners and communities, geologic deposits, ecosystems, technologies, and various levels of scientific and engineering expertise.

This project will break new scholarly ground by developing an integrated, community-centered approach to design, implement, and evaluate socio-technical innovations, which will lead to the long-term sustainability of ASGM practices in Colombia and Peru. The researchers will apply a combination of physical and social science, human-centered design, and engineering methods. The project will engage US engineering students, who will learn how to co-design, implement, and evaluate sustainable and culturally appropriate ASGM technologies and practices in collaboration with miners and affected communities. Other Mines professors collaborating on the project include Kate Smits (Civil and Environmental Engineering), and Juan Lucena (PI) and Jessica Smith (both in the new Engineering, Design, and Society Division); Hugh Miller (Mining Engineering) is on the project's advisory board.

Congratulations to Nicole and Elizabeth!

UTC-UTI Research Project in Waterjet Removal of Shotcrete and Concrete Liners During Tunnel Liner Repair and Maintenance October 2017

Funded by the U.S. Department of Transportation through the University Transportation Center for Underground Transportation Infrastructure (UTC-UTI), this research seeks to develop a unique system that utilizes waterjet technology as the primary excavation tool to circumvent the technical and operating challenges associated with conventional shotcrete removal and repair. Building upon the success of previous CSM research in underground rock scaling and scarification, empiric evidence indicates that waterjets are capable of selectively removing damaged areas of support liners without structurally compromising or damaging intact material around the area being repaired. The primary research objective is to compare and contrast the unintended damage caused to the surrounding structural liner and rock substrate by both mechanical impact hammers and waterjet excavation methods during empiric testing. This analysis will involve physical testing on instrumented shotcrete panels designed to quantify fracture propagation, substrate delamination, and stress distribution with the intent to facilitate a better understanding of the dynamic excavation processes associated with liner repair. Led by an interdisciplinary project team comprised of Hugh Miller, John Steele and Brian Asbury, working in collaboration with industry partners, this project incorporates the efforts of several graduate and undergraduate students from different departments in hopes of providing a valuable hands-on learning experience that seeks to address a relevant industry challenge. For more information, please contact Hugh Miller.

Recent Project Awarded to Mines by NASA

MATERIAL CHARACTERIZATION WHILE DRILLING ON MOON AND MARS

PI: Jamal Rostami, PhD, PE, CO-PIs: Alfred Eustes PhD (Petroleum Eng.), and Chris Dreyer, PhD (Center for Space Resources and Mechanical Eng.), Steve Nieczkoski (Thermal Space Ltd., Boulder, CO). In this research, the Colorado School of Mines (CSM) research team



Figure 1. Drawing and Picture of CSM Drillbot

will draw upon the expertise in drilling for mining and petroleum applications, as well as the field of robotics in mechanical engineering, and top experts in the design of systems for cryogenic conditions to develop an intelligent drilling system for characterization of Lunar / Martian regolith and subsurface formations. The project includes the modification of the drilling robot (Drillbot) at CSM (Figure 1) to include the additional sensory systems needed, and data analysis programs recently developed for characterization of the ground

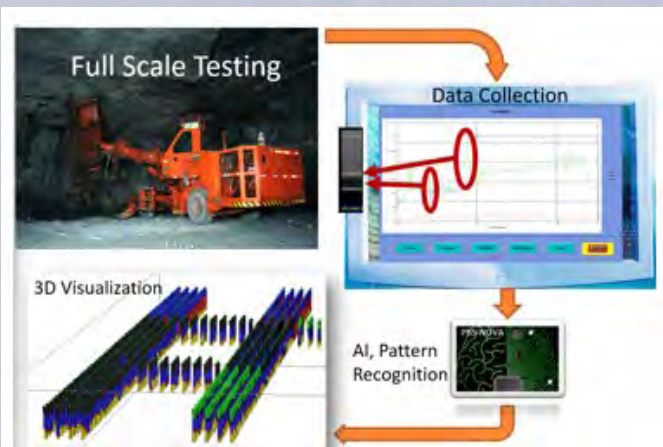


Figure 2. Schematic of the process from drilling to 3D model of the ground.

from field measurements (Figure 2) to offer the ability to identify various material types and their strength properties.

Mining Engineering's Department News

New Research Grants Awarded to Faculty

Project Title	PIs from Mining Engineering	Sponsor	Amount	Project Dates
Analysis and Optimization of the Use of o'bellx® Avalanche Control System	Vilem Petr	CDOT	\$170,000	8/23/17 - 1/31/19
Combustion Modeling and Spon Com Prevention in Longwall Gobs	Jurgen Brune	National Institute for Occupational Safety and Health	\$291,269	9/01/17 - 8/31/18
Development of A New Stochastic Mine Production Scheduling Optimization Algorithm - Amendment	Kadri Dagdelen	Newmont USA Limited	\$105,049	6/01/17 - 1/9/18
Enhanced Safety and Health Training for Western Mine Workers	Hugh Miller	National Institute for Occupational Safety and Health	\$481,990	9/01/17 - 8/31/18
Explosive Safety Training with Colorado School of Mines	Vilem Petr	CDOT	\$61,277	6/24/17 - 6/23/18
From Mine to Market: Adding Value & Sustainability Across the ASGM Supply Chain through Women Centered Development	Nicole Smith	Bureau of Oceans and International Environmental and Scientific Affairs-OES	\$305,000	10/15/17 - 2/28/19
Hybrid Numerical Simulations of Microstructure Effects and Stress State During Hydraulic Fracture Propagation	Rennie Kaunda	American Chemical Society	\$110,000	9/01/17 - 8/31/19
Performance and Cutter Wear Predictions for a New Vein Mining Machine Operating at the Lucky Friday Mine Based on Linear Cutting Tests and Computer Modeling	Jamal Rostami	Hecla Mining Company	\$58,500	4/01/17 - 8/31/17
Performance and Cutter Wear Predictions for a New Vein Mining Machine Operating at the Lucky Friday Mine Based on Linear Cutting Tests and Computer Modeling	Jamal Rostami	Hecla Mining Company	\$12,000	4/01/17 - 1/31/18
Pressure Wave Characterization for Industry Cleaning Using Bang&Clean Technology	Vilem Petr	Electric Power Research Institute	\$254,321	2/15/17 - 11/15/17
Renewable Energy Feasibility Study at Fort Berthold Indian Reservation	Masami Nakagawa	Department of Interior	\$372,774	7/07/17 - 7/06/18
Self Potential Measurements for Geothermal Resources in Rico	Masami Nakagawa	Rico Center	\$20,000	1/01/17 - 12/31/17
Sustainable Communities and Gold Supply Chains: Integrating Responsible Engineering & Local Knowledge to Design, Implement, and Evaluate Sustainable Artisanal Mining in Latin America	Nicole Smith, Elizabeth Holley	National Science Foundation	\$3,878,858	1/01/18 - 12/31/22
University Transportation Center for Underground Transportation Infrastructure (UTC-UTI)	Priscilla Nelson, Hugh Miller, Rennie Kaunda, Eunhye Kim	Department of Transportation	\$1,416,900	10/11/17 - 9/30/22

Ongoing Faculty Research Projects

Project Title	PI	Sponsor	Project Dates
BCDA - Information	Brian Asbury	Joy Mining Machinery	11/01/11 - 11/01/18
CA - CSV100 Testing	Vilem Petr	United Launch Alliance	7/12/13 - 7/12/20
Combustion Modeling and Spon Com Prevention in Longwall Gobs	Jurgen Brune	National Institute for Occupational Safety and Health	9/01/14 - 8/31/19
Consortium Agreement - National Armaments Consortium	Vilem Petr	National Armaments Consortium	10/16/16 - 9/30/25
Development of an Integrated Approach to Stress-Related Ground Hazards in Underground Mines	Eunhye Kim	Centers for Disease Control- CDC	9/15/16 - 9/14/21
Dispersibility Testing of Dried Wet and Foam Rock Dust	Jurgen Brune	National Institute for Occupational Safety and Health	9/15/16 - 9/14/18
EAGER: Collaborative Research: Dating Mineralization in a Carlin-type Gold Deposit: A Test of the Fe-oxide (U-Th)/He chronometer	Elizabeth Holley	National Science Foundation	6/01/16 - 12/31/17
EAGER: Exploratory Research on Rock Damage from Geologic and Induced Thermal Loading	Rennie Kaunda	National Science Foundation	8/01/15 - 7/31/18
Explosive Safety Training with Colorado School of Mines	Vilem Petr	Colorado Department of Transportation - CDOT	6/24/15 - 6/23/20
Rock Cut Perimeter Blasting BMP Study: Rock Excavation Best Management Practice	Vilem Petr	Colorado Department of Transportation - CDOT	7/01/16 - 12/31/17
Technology, Training, and Capacity Building in Artisanal and Small-Scale Gold Mining: Using Mobile Training Units to Promote Cleaner, Safer, and More Sustainable Livelihoods in Peru	Nicole Smith	Bureau of Oceans and International Environmental and Scientific Affairs -OES	9/01/16 - 2/28/19

CONTRIBUTERS: MN faculty, staff and students **EDITORS:** Rennie Kaunda, Nicole Smith, Priscilla Nelson and Justine Robinson