COLLEGE OF ENGINEERING
MINING AND MINERALS ENGINEERING
VIRGINIA TECH™

WINTER
2018

At the Hokie Stone Quarry, Blacksburg, Virginia

On the cover: Undergraduate Field Trip to Lhoist's Kimballton mine in Giles County, Virginia.

Dr. Erik Westman

Dear Alumni, Supporters, and Friends,

I hope that this special issue conveys a sense of all that is happening within our department as well as the gratitude that we feel to so many of you who faithfully and generously support the department. We have an amazing team comprised of students, staff, faculty, alumni, and friends - great strength and breadth combining to serve the mining industry as it serves our country and the world. Truly this team embodies the Virginia Tech motto of Ut Prosim!

One of the most significant activities that is occurring is the design for the renovated Holden Hall. The plan is to demolish the one-story portion of Holden and rebuild it to four floors. The front section of the building will remain intact but will be renovated and updated. The design is maturing though it cannot be shared until it is approved by VT's Board of Visitors near the end of March. Demolition is currently expected to start in May of 2019.

Our faculty members have also been very active with establishing new research expertise and funded projects. Although there are several new and significant projects, the separation of rare earth elements from coal and associated byproducts is noteworthy. And while the research funding is substantial, we remember that it supports our primary mission which is to prepare students that will positively impact their communities through their service and leadership.

Finally, we look forward to refining our departmental Mission, Vision, and Values this spring and summer; the outcome will be shared with you this fall.

Again, thanks for your support of our department, and Go Hokies!

ERIK

Erik Westman
Department Head
Virginai Tech Department of
Mining and Minerals Enineering

1908: First Virginia Tech mining

Holden Hall, Spring 2017

2020: The New Holden Hall?

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Dr. Yoon Receives $6 Million Award to Recover Crucial Rare Earth Elements

Virginia Tech researchers led by University Distinguished Professor Roe-Hoan Yoon have been selected by the U.S. Department of Energy to build and construct a pilot plant to extract rare earth elements from coal and coal byproducts.

The overall $6 million award for the project is a continuation of an earlier $1 million grant. The pilot plant will be constructed in the central Appalachian coalfields, and participating companies will provide an additional $1.5 million to share the project cost.

Rare earth elements are a set of 17 unique chemical elements found throughout the earth's crust. They are essential components in modern technologies, ranging from electronics and computer and communication systems to transportation, health care, and national defense.

Producing rare earth elements economically in the U.S. has been a challenge due to competition from low-cost producers abroad. With the recent closure of the only rare-earths-producing mine in the country, the U.S. relies entirely on foreign imports, mainly from China.

Coal and coal byproducts might contain upward of 11 million metric tons of rare earth elements. However, an efficient, safe, and economical means for extraction has not been available — until now. "Virginia Tech has led the way in researching rare earth element extraction from coal and its byproducts," said Congressman

Dr. Roe-Hoan Yoon

Morgan Griffith. "Funding for a pilot plant means that the possibilities of applying this technology are more promising than ever before. This project has shown great potential for the future of the coalfields and for our economy."

The challenge with extracting rare earth elements from coal byproduct is that the concentrations of the elements are low, and the grain size of the elements is small, typically less than 5 microns.

"Rare earth elements are actually not as rare as they say," explained Yoon, who is also the Nicolas T. Camicia Professor in Virginia Tech's Department of Mining and Minerals Engineering. "What makes them rare is the difficulty in separation."

Yoon and his group developed novel separation and extraction methods to meet the challenges, including the patented hydrophobic-hydrophilic separation process that can recover ultrafine particles. An advantage of extracting rare earth elements from coal byproducts is that the cost of mining has already been paid for during the course of producing coal.

In the DOE-funded project, the new separation processes will be tested at a pilot scale to collect scale-up and cost information. The success of this project will be a stepping stone for producing salable rare earth oxides commercially in the coalfields of Central Appalachia.

The co-principal investigators for the project include Gerald Luttrell, the E. Morgan Massey Professor of Mining and Minerals, and Aaron Noble, associate professor of mining and minerals engineering. The project will be carried out in cooperation with the University of Kentucky and the Minerals Refining Company of Richmond, Virginia.

Yoon earned his bachelor's in mining engineering from Seoul National University in 1967 and his Ph.D. in metallurgical engineering from McGill University in 1977. He joined the Virginia Tech mining and minerals engineering department in 1978 and holds its Nicolas T. Camicia Professorship. Dr. Yoon is the director of the Center for Advanced Separation Technologies, and is recognized internationally for his pioneering contributions to the technology and science of mineral processing.

Virginia Tech teams with Colorado School of Mines to help success rates of minerals explorations

Mining companies spend billions of dollars each year exploring for the metals, minerals, and energy resources that are central to our industrialized world, but not every exploration activity is successful, often leaving mining companies coming up empty.

Now, Virginia Tech researchers are teaming with the Colorado School of Mines to use earth science and mining expertise to create data sets and 3-D software models that better locate, categorize, and visualize mineral resources to improve exploration success rates. The effort combines the knowledge of mathematicians, computer scientists, geologists, and mining engineers, with industrial and government partnerships. The two universities hope to form the national cross-disciplinary Center for Advanced Subsurface Earth Resource Models, a consortium that would provide mining and minerals companies worldwide with 3-D subsurface geological models that result in more exact drilling.

The Virginia Tech group involves faculty from the departments of Geosciences, Statistics, and Mathematics, and the Computational Modeling and Data Analytics program, and with the Department Mining and Minerals Engineering. Chung is serving as leader for Virginia Tech, with John Hole of geosciences and Erik Westman of mining and minerals engineering as co-primary investigators. Ric Wendlandt will head Colorado School of Mines research efforts.

The effort has early support from the National Science Foundation (NSF), which has awarded each univeristy an initial $15,000 grant to form planning committees, recruit potential industry supporters, and create the consortium under the NSF's Industry/University Cooperate Research Center. Under the proposed project, geosciences faculty will use expertise in geophysics to support mathematicians, statisticians, and computer scientists to create high-performance computing and big data sets to build accurate images of the earth's subsurface in order to help mining engineers in their exploration and development desings.

Currently, companies rely on intensive drilling programs with various degrees of success, with many years spent on a project from initial exploration to production through mine closure and reclamation. This results in lost money, time, and unwanted environmental damage on mines that prove unsuccessful. "Our proposed technologies can have a positive impact on human health and safety," said Westman, adding that every drill operation carries risk.

The consortium would work closely with industry peers from mining, geophysics, big data, and software development, plus federal agencies such as the U.S. Department of Energy and the U.S. Geological Survey on specific projects. Industry support is vital for the group to receive full funding from the National Science Foundation. During this early phase, Virginia Tech and Colorado School of Mines will seek $150,000 from interested companies to join the consortium. Future NSF funding would be used to transition the center into self-sustainability. The group also would fund graduate student researchers for the colleges of Science and Engineering.

"Collecting data and using mathematical models as tools to make informed decisions to minimize risk while maximizing return on investment during excavations has been a long-term goal of the mining industry," said Sally C. Morton, dean of the College of Science. "Having our faculty in mathematics and statistics who specialize in computational modeling and data analytics working with geoscientists and mining engineers at Virginia Tech is another of the ways we at the College of Science are dedicated to building new business models dedicated to obtaining and using data to make smart business decisions."

"Being a land-grant university, we are committed to serving our community, but also strive to reach beyond to improve the human condition on a larger scale," said G. Don Taylor, the Charles O. Gordon Professor of Engineering and interim dean of the College of Engineering. "By partnering with colleagues in the College of Science, the Colorado School of Mines, and industry, together we can positively impact the mining industry by using progressive technology to enhance health and safety of miners."

Virginia Tech Research Advances Solutions for Critical Energy and Carbon Emission Challenges

Researchers at Virginia Tech's mining and minerals engineering department and the Virginia Center for Coal and Energy Research have stepped up to the plate to take on a National Academy of Engineering grand challenge by developing methods, providing assessments, and conducting ongoing research into the injection of carbon dioxide (carbon sequestration) into unconventional storage reservoirs in the Central Appalachian Basin.

The growth of carbon dioxide emissions has been implicated as a prime contributor to global warming and is identified as one of the National Academy of Engineering's "Grand Challenges," a list of 14 critical issues ranging from health and security to sustainability and the environment, considered essential for humanity to flourish. One promising solution is carbon sequestration, a process for capturing carbon dioxide and storing it safely away from the atmosphere. The work being carried out at Virginia Tech focuses specifically on Carbon Capture, Utilization and Storage (CCUS), whereby a process is developed which economically extracts natural gas from wells while creating pore space for storing carbon dioxide.

Dr. Nino Ripepi, assistant professor in the department of mining and minerals engineering, has served as lead project manager for a series of funded projects, spanning multiple phases. He is joined by co-principle investigators Michael Karmis, department Stonie Barker Professor and Director of VCCER, and Ellen Gilliland, department assistant professor.

The overarching project, CO2 Injection Projects in Unconventional (Coal/Organic Shale) Reservoirs, seeks to test the storage potential of unmineable coal seams and shale reservoirs while better understanding the adsorption and swelling behaviors between methane and CO2. The research is funded by the US Department of Energy and the National Energy Technology Laboratory (NETL), with funding and donation of wells cost-shared from industry partners.

The first phase of the research focused on the identification and characterization of potential on-shore geologic formations suitable for carbon storage. Results from this first phase indicated the potential for both enhanced gas recovery as well as significant storage capacity in the Central Appalachian Basin.

The second phase of the work consisted of "Huff and Puff" tests in several vertical coal bed methane (CBM) wells and one horizontal shale gas well. Tests were carried out in Russell and Buchanan Counties, Virginia, for the vertical CBM wells, and in Morgan County, Tennessee, for the horizontal shale well. Huff and Puff testing is a cyclic process by which a well is injected with a fluid or gas to aid in the recovery of methane or test the

Nino Ripepi, Assitant Professor

Nino Ripepi has extensive experience managing federally funded energy related research projects for the Virginia Center for Coal and Energy Research, with funding from the U.S. DOE, U.S. EPA and NIOSH. These research projects are focused on environmental, health and safety issues related to coal mining, unconventional gas development, biomass utilization and carbon sequestration. Nino is currently the project manager for two on-going U.S. DOE funded carbon sequestration pilot projects aimed at enhancing gas recovery from coalbed methane and shale gas plays in the eastern U.S. He has previous experience working in surface and underground coal mines, including coal mine methane degasification development. Dr. Ripepi holds both a Ph.D. and Bachelor's degree in Mining Engineering from Virginia Tech and is an active member of the Society of Mining, Metallurgy and Exploration, the Society of Petroleum Engineers, and the Society of Mining Professors.

Dr. Nino Ripepi

reservoir's capacity to store injected CO2. Phase two, funded at $12.5 million, resulted in the successful injection of over 14,000 tons of CO2 in the three vertical coal bed methane and one horizontal shale gas wells, indicating high storage capacity and the potential for commercialization and economic development.

The promising results of the on-shore projects allowed the Virginia Tech team to shift its sights offshore for the third phase of its research. The Southeast Offshore Storage Resource Assessment, or SOSRA, is a 3-year research initiative receiving over $1 Million in funding by the U.S. Department of Energy. This project aims to provide high-quality assessment of prospective carbon dioxide storage resources off the Eastern Gulf of Mexico as well as the Mid and South Atlantic Seaboards. Results of this work have provided an overview of the basic geological framework of the Mid-Atlantic region as well defined key planning areas. The team has identified three zones in the Mid-Atlantic region favorable to carbon dioxide sequestration: the Baltimore Canyon Trough, the Carolina Trough and the lower Potomac Aquifer that could be future test sites to verify the efficacy of carbon storage.

Dr. Nino Ripepi initiates CO2 injection in a CBM well in Buchanan County, VA

Aaron Noble Joins Department as Associate Professor

Dr. Aaron Noble

Aaron Noble has been appointed associate professor in the Department of Mining and Minerals Engineering at Virginia Tech after serving as assistant professor at West Virginia University. Noble received his bachelor's, master's, and doctoral degrees in mining engineering from Virginia Tech.

"The mining and minerals engineering department at Virginia Tech has a rich tradition of scholarly activity, research commercialization, and instructional excellence," Noble said. "I believe that my work will be a great fit here, and I look forward to maintaining and even building the department's prestige and notoriety into the next generation."

While serving as assistant professor of mining engineering at West Virginia University, Noble obtained more than $1.1 million in research grants and contracts and supported a research staff that included several graduate students, post-doctoral fellows, international exchange students, and undergraduate researchers.

Noble's teaching and research focus in the general areas of mineral processing, techno-economic process analysis, and environmental pollution control. His specific interests include industrial waste recycling, critical material recovery, and off-earth mining systems development. In the past, he has received funding from the U.S. Department of Energy, NASA, and other private sources to support these endeavors.

In addition to his research, Noble will be teaching undergraduate and graduate courses in mineral processing, process simulation, and economic evaluation of mineral deposits at Virginia Tech. Noble also plans to support other non-academic student activities related to professional development and industrial networking. He emphasizes the value of undergraduate research, and many of his prior students have had success in various national and state competitions.

"I believe the mining faculty at Virginia Tech are among the best in the nation, and I consider it an honor to be a part of this group," said Noble.

Noble currently serves as a Henry Krumb Lecturer for the Society for Mining, Metallurgy and Exploration. He is the recipient of the Rossiter W. Raymon Award and Stefanko Best Paper Award. In 2015, Noble was awarded an Society for Mining, Metallurgy and Exploration Academic Career Development grant.

Virginia Tech and Department Emerge as National Leader in Rare Earth Extraction from Coal

Since joining Virginia Tech in June, 2017, Dr. Aaron Noble, mining and minerals engineering department associate professor, has secured approximately $2 Million in Department of Energy funded projects aimed at developing technologies for recovering rare earth elements from coal and coal byproducts.

The projects will be managed by the National Energy Technology Laboratory, and the most recent awards are supported through the funding opportunity announcement, *Development of Separation and Extraction Processes for Production of Rare Earth Element (REE) Materials from Domestic U.S. Coal and Coal By-Products*.

These awards come on the heels of an earlier award to Virginia Tech University Distinguished Professor Roe-Hoan Yoon. Under that $6 million funded project, Yoon and his research team at the Center for Advanced Separation Technologies (CAST) at Virginia Tech will design and construct a pilot-scale plant for recovering REEs from coal byproducts. The CAST group, which currently includes Yoon (CAST Director), Noble (CAST Associate Director), and Dr. Gerald H. Luttrell, has had notable success in the past in developing and commercializing technologies for the coal and minerals industries. With these awards, Virginia Tech and CAST are uniquely positioned to expand their expertise and become a leader in rare earth extraction from coal.

The projects are expected to be completed by 2020 and are seeking to develop both bench-scale and pilot-scale technologies to economically separate, extract, and concentrate mixed REEs from coal and coal byproducts, including aqueous effluents. While coal material does tend to have elevated concentrations of REEs, the form and structure of the elements create challenges in the separation process. This technical challenge creates a need for novel and innovative processing solutions to successfully extract REEs in an economic and environmentally-benign manner.

With the new awards, Noble is collaborating on a series of initiatives being carried out several universities, including the University of Kentucky, West Virginia University, the University of Utah, and Virginia Tech. Individual projects will examine a wide range of research issues such as the screening and evaluation of REEs in acid mine drainage discharges, the evaluation of mineralogy and leachability from coal feed stocks, identifying cost effective extraction processes for REEs from clays and shales associated with coal, and the development of extraction methods based on integrated heap leaching and solvent extraction.

The demand for REEs, which are critical elements for many modern technologies, has grown significantly in recent years, necessitating the development of economically feasible approaches for recovering them domestically. These new projects will further the goals of the DOE Office of Fossil Energy's Rare Earth Elements Program by focusing on the development and validation of cost-effective and environmentally benign approaches for recovering REEs from coal resources. If successfully implemented, this research will not only provide a secure domestic feedstock for critical raw materials, but will also create additional jobs in coal communities.

Erik Westman, Professor, Department Head

Erik serves as Professor and, since 2016, Head of the Department of Mining and Minerals Engineering. Prior to this he was the interim associate dean for academic affairs for the College of Engineering. He has served as the faculty advisor for his department's senior design project that is submitted annually to the Carlson Software Senior Design Competition. Under Erik's leadership, nine teams have garnered national championship first-place victories. His research efforts have focused on developing novel methods for geotechnical monitoring of the entire rock mass volume rather than only point locations.

Together with his students, Westman's most significant accomplishment was pioneering the use of passive seismic tomography to image time-lapse, stress-induced changes near the face of a longwall coal mine. The National Science Foundation, the National Institute for Occupational Safety and Health, and the U.S. Department of Energy have supported Erik's work in this area. Erik has been an invited speaker to numerous symposiums and conferences, including as the Society for Mining, Metallurgy, and Exploration Henry Krumb Lecturer. In 2002, he won a National Science Foundation CAREER Award to develop a practical method for predicting failures in rock masses. Westman worked for the U.S. Bureau of Mines from 1991 to 1996. Prior to becoming a faculty member at Virginia Tech in 1999, Erik also spent five years in consulting engineering in addition to five years with the Denver Research Center of the US Bureau of Mines. He earned a bachelor's from the Colorado School of Mines, a master's from the University of Colorado, and a Ph.D. in mining and minerals engineering from Virginia Tech.

Michael Karmis, Stonie Barker Professor, Dirctor VCCER

Dr. Michael Karmis is the Stonie Barker Professor of the Department of Mining and Minerals Engineering and the Director of the Virginia Center for Coal and Energy Research (VCCER) at Virginia Tech.

His expertise is in the areas of geomechanics and mine systems, health and safety, carbon management and energy planning, and the sustainable development of energy and mineral resources. He has authored/co-authored over 200 scientific papers and directed/co-directed 65 major research projects valued at +$60million. His research has been funded by federal and state agencies, foundations and the private sector.

Dr. Karmis served as the 2002 President of the Society for Mining, Metallurgy and Exploration (SME) and as the 2008 President of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME). He was elected as the 2002 President of the Society of Mining Professors (SOMP)-Societät der Bergbaukunde and served from 2005 to 2012 as the Society's Secretary General.

A Professional Engineer (P.E.) in the USA and a Eur Ing in Europe, Dr. Karmis is an active consultant to the global mining industry, academic and research institutions, government agencies, engineering companies, and financial and legal firms. Dr. Karmis serves as President of the Alpha Foundation for the Improvement of Safety and Health.

He is an Honorary Member of AIME, a Distinguished Member of SME, a Fellow of the Institute of Quarrying, and a Fellow of the Institute of Materials, Minerals and Mining. He has received numerous awards and recognitions by major scientific, educational, professional and industrial organizations.

Gerald H. Luttrell, E. Morgan Massey Professor

Dr. Gerald (Jerry) Luttrell is the E. Morgan Massey Professor in the department of mining and minerals engineering. His expertise in process engineering has contributed to the development of a variety of innovative technologies for primary and secondary materials processing. A Hokie through and through, Luttrell received his bachelor's, master's and doctoral degrees in mining and minerals engineering from Virginia Tech in 1980, in 1982, and in 1986, respectively. Since joining the faculty in 1986, he has conducted nearly $30 million in sponsored R&D projects, received 22 patents, and authored over 300 book chapters, journal articles and conference proceedings. Known as "Mr. Prep" throughout the coal preparation industry, Luttrell also conducted 68 short courses and 156 workshops for more than 800 industry personnel.

Luttrell is the recipient of numerous professional awards and honors including the Antoine Gaudin Award (2017), Stefanko Best Paper Award (2014), SME Distinguished Member (2014), CPSA President's Award (2013), Robert H. Richards Award (2012), ACPS Arthur LePage Memorial Lecturer (2011), Henry Krumb Lecturer (2009, 2000), Frank F. Aplan Award (2007), Percy Nicholls Award (2005), and PCMIA Stephen McCann Educational Excellence Award (1995). He is also a multiple recipient of his department's Outstanding Faculty Award and of Virginia Tech's Academy of Teaching Excellence Award. In 2013, Luttrell was inducted into the National Academy of Engineering, one of the highest professional distinction accorded engineers. His nomination was based on his pioneering and advancement of new separation technologies for the mineral and coal industries.

Kray Luxbacher, Professor, Associate Department Head

Dr. Kray Luxbacher is professor and associate department head of mining and minerals engineering. Prior to joining the department in 2008, she worked as an industrial engineer and underground production foreman for Consol Energy. She is a registered professional engineer in Virginia, and has held certification as an underground coal mine foreman. As Associate Department Head, Luxbacher oversees curriculum development, assessment and accreditation, the graduate program and numerous student-oriented activities.

Her primary research interests are in underground mine ventilation, mine health and safety, and unconventional oil and gas reservoir engineering, with involvement in research projects totaling over $6 million. In a National Institute for Occupational Safety and Health (NIOSH)-funded project, Luxbacher examines simulation of underground mine fires as well as novel fire fighting methods. Other projects, with more than $1 million from coal companies, examine real-time monitoring of underground atmospheres to create safer work environments.

Luxbacher currently advises 7 graduate students and has published over 50 papers. Her research sponsors include the National Institutes for Occupational Safety and Health, the Alpha Foundation for Improvement of Mine Safety and Health, members of the mining industry, and the US Environmental Protection Agency. She is an active member of the Society for Mining, Metallurgy and Exploration and the Society of Mining Professors (Societät der Berbakunde). She was recognized by the VT College of Engineering in 2011 with the Dean's Award for Outstanding New Assistant Professor, and is a recipient of SME's J.W. Woomer Award for young engineers.

Emily Sarver, Associate Professor

Dr. Emily Sarver is an Associate Professor of Mining and Minerals Engineering and is also adjunct faculty to the Via Department of Civil and Environmental Engineering. Emily, as she prefers to be called, is one of only a handful of environmental specialists working within mining engineering programs across the nation. Her research and teaching are focused across a range of environmental topics – from characterization and monitoring of occupational and environmental contaminants, to sustainable development practices – which span industry, government, and community interests. As a recognized expert on airborne particulates in mines, she has recently served on a National Academies of Sciences, Engineering, and Medicine committee to study respirable dust sampling and monitoring in coal mines. She also has expertise in extractive metallurgy and corrosion.

Since joining our faculty in 2011, Emily has been involved in nearly $4 million in sponsored research and advised or co-advised 18 graduate students across the mining, environmental, and biological systems engineering disciplines. At the graduate level, she teaches an innovative course on Sustainable Development of Mineral and Energy Resources which is co-offered synchronously with two external institutions. Emily is well-known by our undergraduate students too, as she generally teaches both the sophomore-level Introduction to Mining Engineering and the senior-level Environmental Management and Mine Reclamation courses. She also serves as an academic advisor for students wishing to minor in Green Engineering or study abroad, and a student organization advisor.

Among her recent honors, Emily received the 2016 Mineral Processing Division Young Engineer and the 2017 Health and Safety Division Research and Teaching Excellence awards from SME. In 2017, she also received the Outstanding Young Alumni Award from the Via Department of Civil and Environmental Engineering. In 2015, she and collaborator Dr. Leigh-Anne Krometis (VT BSE) were jointly recognized with the Outstanding Researcher Award by the Appalachian Research Initiative for Environmental Science. Emily is an active member of SME and the Society of Mining Professors, where she has recently worked to establish a mentoring program for junior and aspiring faculty.

Bahareh Nojabaei, Assistant Professor

Dr. Bahareh Nojabaei joined the department in 2016, after having served as an academic professional lecturer at the University of Wyoming. Her appointment is part of the Virginia Tech and University of Nottingham's joint initiative, Best with Best Alliance, designed to enable high-impact research aimed at addressing the security, supply, affordability, and sustainability of global energy resources. She earned her bachelor's degree in mechanical engineering from Iran University of Science and Technology, her master's degree in mechanical engineering (energy conversion) from Amirkabir University of Technology (Tehran Polytechnic), and her doctoral degree in energy and mineral engineering from Pennsylvania State University.

Bahareh's research interests include geoenergy engineering, enhanced oil and gas recovery, unconventional gas and oil production, CO2 sequestration, thermodynamics and phase behavior of reservoir fluids, and reservoir simulation. She is currently working on gas injection characteristics of shales for enhanced oil recovery purposes. She has developed a graduate level course titled Multicomponent Thermodynamics covering phase behavior of oil and natural gas in petroleum reservoirs. Bahareh is actively involved in two externally-funded projects, namely, feasibility analysis of pumped storage hydropower development in abandoned underground coal mines, and investigation and characterization of emerging shale gas plays in southwest Virginia.

She has authored several peer-reviewed journal papers and has presented in numerous international conferences and meetings. She is co-author of a book entitled "Introduction to MATLAB for Chemical and Petroleum Engineering", which is a student reference specifically designed for chemical, petroleum and energy engineering applications.

Mario Karfakis, Associate Professor

Dr. Mario Karfakis is a department associate professor. He holds a BS in Geology from Scientific University of Grenoble, and earned his MS PhD in Mining Engineering from the University of Wisconsin, Madison. Dr. Karfakis is recognized for his expertise in geomechanics and mining extraction technology, and he has served as principal or co-principal investigator for research projects addressing geomechanics, rock fragmentation, characterization of geomaterials, ground control, AML problems, and environmental impact of excavation and construction in rocks.

His undergraduate and graduate courses focus on rock mechanics and ground control, underground and surface mine design, geotechnic engineering, and excavation engineering. A long-standing member of the International Society of Explosives Engineers (ISEE), Dr. Karfakis was instrumental in setting up the Virginia Tech ISEE Student Chapter—one of the first student chapters in the nation for the explosives society. Dr. Karfakis has authored over 70 publications and produced 7 formal reports or manuals for circulation by state or federal agencies. He is a member of four major professional societies and is an active consultant, editor, publication and proposal reviewer. Dr. Karfakis is a 2002 recipient of the ISEE President Award, and he is a four-time recipient of the Burkhart Mining Society's (Student SME Chapter) Outstanding Faculty Award.

Cheng Chen, Assistant Professor

Cheng Chen holds a BS degree in hydraulic engineering from Tsinghua University, China, and a PhD degree in civil and environmental engineering from Northwestern University. He joined the department in 2015 as its first natural gas engineer, bringing new perspectives and expertise in areas of advanced numerical methods in porous media, multiscale simulation of subsurface flow and transport, and rock characterization using high-resolution imaging. Cheng spent three years as a reservoir engineer and geomechanics project leader for the production enhancement group of Halliburton in Houston, Texas. His work focused on leading the development of the Graphics Processing Unit - Accelerated Lattice Boltzmann Simulator (GALBS) for Halliburton's Digital Rock Laboratory.

Chen's research interests lie primarily in rock characterization using computed tomography and scanning electron microscope imaging, the Lattice Boltzmann method and multi-scale simulations of flow and transport in porous media. This spring Chen has introduced two new graduate courses in the department: "Flow and Transport in Porous Media" and "Numerical Methods for Fluid Flow in Petroleum Reservoirs", as well as an undergraduate course: "GeoEnergy Engineering Fundamentals."

A 2016 recipient of an Institute for Critical Technology and Applied Science's (ICTAS) Junior Faculty Award for Research, Chen's project, "Study of the Effects of Human-Induced Subsurface Fractures on Surface Water-Groundwater Interaction," aims to advance the understanding of environmental and hydrogeological impacts of hydraulic fracturing, a widely used stimulation method for unconventional fossil fuel energy recovery in shale formations.

Ellen Gilliland, Assistant Professor

Dr. Ellen Gilliland is an assistant professor in the Department of Mining & Minerals Engineering and also serves as an affiliated assistant professor at the GeoEnergy Research Centre at the University of Nottingham, United Kingdom. Gilliland earned her bachelor's degree in geophysics from the University of Oklahoma (2006), her master's degree in geosciences from Virginia Tech (2009), and her doctoral degree in mining and minerals engineering from Virginia Tech (2016). She joined the department after having served as a geophysics research associate at the Virginia Center for Coal and Energy Research where she led the monitoring program for a $12 million carbon storage/enhanced gas recovery field project funded by the DOE.

Her research and professional interests include Geophysical monitoring and design, seismology, carbon management and utilization (including enhanced oil/gas recovery), reservoir characterization, clean energy technologies, corporate-public engagement, domestic and global energy policy, and diversity in STEM fields and academia. Currently she serves on a Virginia Tech-University of Nottingham initiative to develop a Graduate Certificate in Geoenergy Engineering. She teaches courses in geopolitical and environmental considerations in energy production, and has taught courses on leadership and ethics in mining engineering.

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Freeport-McMoRan Copper & Gold Foundation

Luck Companies

Marcum Foundation

Martin Marietta Materials, Inc.

Massey Foundation

Minerals Refining Company LLC

Newmont Mining Corporation

Vulcan Materials Company Foundation

Wells Fargo Community Support Campaign

Steven Abbatello is the retired senior vice president and general manager of Global Mining and Colloidal Technologies at Ecolab, a global leader in water, hygiene, and energy technologies and services that protect people and vital resources.

Steven Abbatello

Starting in 1980, Steve worked with Nalco in a variety of positions including field engineer, district manager (Virginia, Texas, Australia), regional manager (Asia Pacific), strategic business leader for heavy industry (Asia Pacific-Singapore based), global marketing manager, general manager global mining, and strategic business leader mining and metals.

He joined Ecolab in 2011 (via acquisition of Nalco) where he oversaw the Global delivery of world-class service, technology, and expertise to make water systems, manufacturing processes, and end products more efficient, profitable, and sustainable. He was responsible for the growth and development of the personnel responsible for business profitability. Commercializing innovative technology was key to customer and business success, and his team deployed flotation and dewatering technology developed by Dr. Roe-Hoan Yoon and his team at Virginia Tech. Steve attributes his successful career to important relationships: "I had the ultimate fortune of having a very strong management team as well as being surrounded by great people—with many being Hokies!"

Steve earned a bachelor's degree in mining and mineral engineering from Virginia Tech in 1980 and also has taken an array of executive education courses. He continues to serve Virginia Tech as a member of the College of Engineering Advisory Board, and he is an emeritus board member for the mining and minerals engineering department. Currently, Steve does independent consulting, leads church mission (home construction) teams, volunteers for veteran's causes, and is a charter fishing Captain on the Texas coast. Steve currently resides in Aransas Pass, Texas, and Smith Mountain Lake, Virginia.

Michael J. Mankosa is a 2018 inductee into the **National Academy of Engineering** for his "engineering contributions to the conception, development, design and application of advanced separation technologies for mineral processing." He is a graduate of Virginia Tech, earning a Doctorate degree in engineering. Dr. Mankosa's graduate work focused on the design, instrumentation and contol of process equipment.

Michael J. Mankosa

Dr. Mankosa served as Director of Research & Development for Carpco, Inc., and later went on to join Eriez Magnetics as Technical Director in 1997 and was promoted to Vice President of Operations in 2003. In this position, he was responsible for Research & Engineering, Information Systems and Manufacturing Operations for Eriez' North American operations as well as President of Eriez Flotation Division, Canada. He has recently been promoted to Executive Vice President - Global Technology and is responsible for all technical aspects of Eriez' global operations as well as evaluation of new business opportunities.

Dr. Mankosa is a member of several professional societies including the American Institute of Mining, Metallurgical and Petroleum Engineers, The Minerals, Metals and Materials Society, the Instrument Society of America and the Coal Prep Society of America. He was named a 2012 department of mining and minerals engineering Distinguished Alumnus. He has authored over 100 articles in scientific and technical journals, has obtained multiple equipment and process patents, and has received over $2 million in research funding from state and federal agencies. Additionally, he has organized and/or participated as a guest lecturer in dozens of short courses and technical workshops throughout the world. He is a member of the Board of Visitors for the Penn State Behrend Department of Engineering as well as the Advisory Board for the Virginia Tech Mining & Minerals Engineering Department. In addition In addition to his professional service, Dr. Mankosa also contributes his time to local not-for-profit charities as a board member for Junior Achievement of Western Pennsylvania and the Greater Erie Area Habitat for Humanity.

Luck Stone leads seniors through exploration of Values-Based Leadership

Luck Stone, one of the the largest family-owned and operated producers of crushed stone, sand, and gravel in the nation, is widely recognized for its generous financial support of Virginia Tech's mining engineering students through scholarships and a highly regarded undergraduate co-op. But the company's impact and support of the program is much wider reaching.

Each spring, Luck Stone representatives descend onto the Virginia Tech campus, and specifically the mining and minerals engineering department, to offer students special workshops and lectures on topics of leadership, sustainability, and community best practices. The company's success in implementing best mining practices and garnering social license from communities surrounding their operations has made them uniquely positioned to share their experiences and offer advice to future mining engineering professionals.

Recently a team of Luck Stone representatives gave an informative presentation and workshop on Value-Based Leadership to seniors in the Mining Engineering Leadership Seminar course, taught by Dr. Michael Karmis. The session was facilitated by Dr. Thomas Epperson, president of InnerWill, a nonprofit started by Luck Companies dedicated to developing positive and impactful leadership skills. Dr. Epperson was joined by Luck Stone's Mine Development and Blasting Manager Bryan Smith (Class of 79), as well as a cohort of recent VT Mining Engineering alumni working with the company.

Organized as a small group workshop, Epperson led students to examine and discuss trends in leadership as well as their own leadership styles. Students were encouraged to actively look for leadership at every level of an organization or company, and each group offered ideas on how they could best align their own values with a company and fellow employees. To conclude the workshop, each of the "Hokie Reps" offered the class a few words on their own experiences as well as advice as they transition from campus to quarry, site, or company setting.

The presentation was a big hit with the students. "The workshop really gave us a different perspective on what it means to be a leader," noted Max Dedrick, a senior in the class. Fortunately for the students, Luck Stone will be returning later in the semester for its second workshop on social license and community best practices.

FROM CAMPUS TO CAREER

Department's Career Fair Introduces the Industry to the Next Generation of Mining Engineers

Now into its second year, the department's annual fall Mining Career Fair is helping connect students with top mining and minerals companies looking to hire full-time engineers as well as summer interns.

The 2017 Fair was held the first week of October. The first day of the event was an expo where students were able to visit company booths, speak with recruiters and learn more about the company and job opportunities. At this time students presented their resumes and set up interviews for the following day. Company turnout increased by almost 60% over the first career fair, reflected by the thirty-four recruiters representing nineteen companies.

For years the department enjoyed an active and busy recruiter program, with company representatives visiting Holden Hall on an almost weekly basis. But with diminishing office and lab space, as well as the impending rennovation of Holden Hall, the two-day Career Fair format is proving a great way to keep students connected to careers.

But the fair is not a company's only chance. Throughout the year, companies continue to visit and recruit on campus, first providing department undergraduates with an informal evening info-session, followed by interviews the next day conducted at Virginia Tech's Career Services offices.

The 2017 Fair resulted in the hiring of 18 summer work and intern positions, plus 12 permanent hires. While clearly a boon for students, there are real benefits for the participating companies. "One of the biggest advantages for employers attending the fair," according Michelle Crotto, department academic advisor and organizer of the event, "is that they are exposed to nearly all of the department's student body." Just under 85% of department undergraduates attended this year's fair.

The event also offers employers the flexibility of interviewing as many or as few candidates as they need. In addition to the easy interview format, companies have the valuable opportunity to expose their brand to the next generation of mining engineers.

While not every student walks away from the fair with a summer or permanent job, the process helps them develop critical career-related skills. "There is great development for our students as they begin learning how to network," explains Michelle. "This event is often times a student's first experience walking up to a potential employer and introducing themselves." The skills associated with pursuing a job and career—from writing a resume to confidently navigating a tricky interview—are skills that will serve the undergraduates in the future.

Plans are already under way for the 2018 Fair, which will be held on October 4 and 5, 2018. While recruiter registration has not opened yet, companies interested in participating or hiring Virginia Tech mining engineers, can contact the department academic advisor, Michelle Crotto, at mcrotto@vt.edu or check the department website at www.mining.vt.edu.


CARGILL


Vulcan
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BUILT ON
ESSENTIALS

Graduate Research

Students Combine Three Approaches to Improve Ground Control Safety

With the faculty's ongoing success in securing funding for innovative research, the department's graduate students are afforded numerous opportunities to take part in critical, challenging projects of their own. There are currently 27 students pursuing their master's or doctoral degrees in mining engineering, and many of them participate in projects that have real-world implications for the industry and worker safety.

One of these projects is the Ground Control Research for Improving Safety Performance in underground Stone and Other Large Opening Mines, which is led by Dr. Nino Ripepi. The work seeks to addresses important ground control safety issues related to large opening underground mines, with an emphasis on room and pillar stone mines. In addition, the project aims to develop and train a new generation of ground control experts specializing in underground mine stability in order to ensure the future health and safety of mine workers in this sector.

Three graduate students have joined the project, and, while they each have developed different methodologies towards the research problem, their work addresses issues of ground control safety in complementary ways.

Juan J. Monsalve, a department master's candidate, earned his B.S. in Mining and Metallurgical Engineering from the National University of Colombia in 2016. He worked as an engineer assistant for geotechnical design companies in Colombia, where he gained experience in rock mass characterization and numerical modeling for underground excavations. His research focuses on recreating the structure of a rock mass by using laser scanning and mapping natural fractures that can generate rock falls in tunnels. Once the natural discontinuities present in the rock mass are identified, they are modeled in a software that uses discrete element methods, which are able to estimate the amount, volume, size and kinematics of possible displaced blocks due to the excavation.

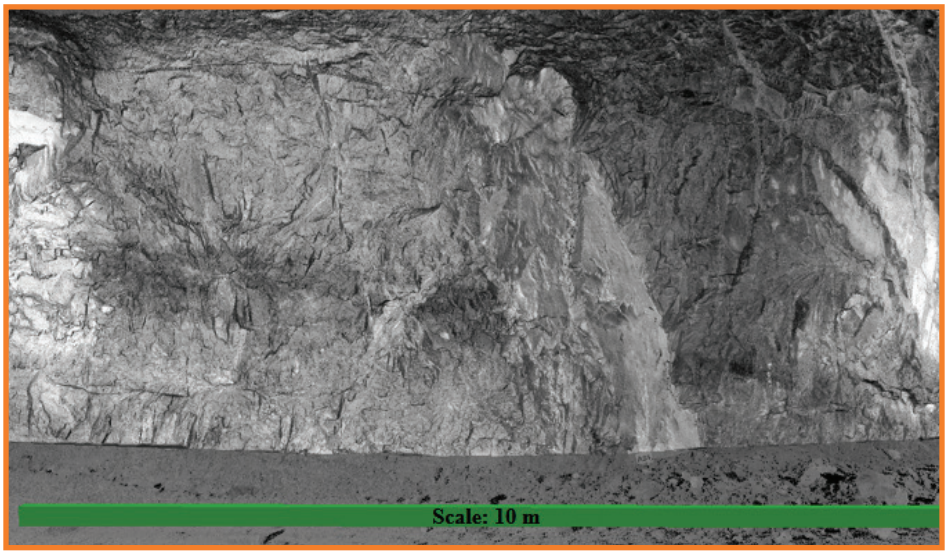
Jon Baggett, who completed his B.S. in mining engineering in the spring of 2017, is also pursuing his M.S. degree at the department. He has experience working as a summer intern at a surface phosphate operation in Florida as well as at surface aggregate operations in North Carolina. Jon's research addresses the risks of water inrush from karstic features in underground mining environments operating in carbonate rock masses. Karsts are complex and challenging ground control risks, and traditional methods of predicting their locations, such as probe drilling, probability studies, and borehole data analysis, are often impeded by the inconsistent spatial distribution and variable sizes of the features. His research aims at demonstrating how the use of Ground Penetrating Radar (GPR), a geophysical

technique that transmits radio waves into a medium and subsequently detects transmitted waves via a receiver, can be used to detect karsts in 3 dimensions. GPR has been extensively researched in both commercial and academic domains; however, its application in underground mines lacks a significant amount of research.

In a third project, Richard Bishop tests the use of photogrammetry as an effective means for site characterization and ground control monitoring in large opening underground mines. A Class of 2001 mining and minerals engineering graduate, Richard returned to Virginia Tech to complete his Master's degree and start his Ph.D. after most recently working 8 years in Toronto, Canada, in mining finance, where he maintains a consulting business. He was the Vice President of Investments for Aberdeen International, a Canadian mining investment firm, while serving as Interim CEO for two junior mining company startups. With industry experience in gold, molybdenum, titanium, tungsten, and phosphate, Richard holds a graduate certificate in Mining Engineering from the European Mining Course, and he serves on the Advisory Board of Virginia Tech's Mining and Minerals Engineering department. Richard's work involves photogrammetry, a proven technique for capturing composite images for 3D spatial analysis. Richard's work tests the feasible application of photogrammetry for site characterization and ground control monitoring in large opening underground, thereby improving overall safety through hazard recognition, risk assessment and ground control best practices, which can then be implemented into training and operations management.

Richard Bishop performs a photogrammetry survye of an underground pillar.

Juan J. Monsalve conducts a manual discontinuity mapping to compare with laser scanned models.



Preliminary results of laser scanned area shows some of the natural fractures or discontinuities present along the excavation.

Student Organizations

The department is proud of its many students who, in addition to their course work, find time to volunteer or lead in organizations. Here are highlights from their busy 2017-18 academic year.

Burkhart Mining Society

The Burkhart Mining Society is the student chapter for the Society for Mining, Metallurgy and Exploration (SME) and is one of the oldest student chapters at Virginia Tech. Burkhart recently won the Grand Prize in SME's 2017 Membership Challenge, recruiting the highest number of new and renewed student members! Burkhart will be recognized with a monetary award, an article in Mining Engineering magazine and mentioned at the 2018 SME Annual Conference & Expo.

Bev Watford Society

One of our newest organizations, the Bev Watford Society (BWS) takes is name from department distinguished alumnus and current Virginia Tech Associate Dean of Academic Affairs, Bevlee Watford. BWS played a big role this past year in spreading the good name of mining and minerals engineering to undeclared freshmen engineering students. In the past year, its student members have organized more than 8 outreach, recruiting events and field trips to nearby mining operations.

Mining Competition Team

The Mining Competition Team, a.k.a. "Mucking Team," has been training hard for this year's International Mining Games at the Camborne School of Mines, England, held from March 26-30. Each year the team competes against other mining engineering schools in a variety of old-time, hands-on mining methods. To prepare for this year's event team members Joe Tabor, John Molnar, Adam Hess, Matt Sweitzer, Stuart Smith, Nick Cirillo, and Haley Sparkman have been building muscle and skills both in Blacksburg and recently during an informal regional competition in Kentucky.

Bryan Smith Aggregates Society

Named for department distinguished alumnus and Luck Stone Mine Development and Blasting Manager, the Bryan Smith Aggregates Society is the Virginia Tech student chapter of the National Stone, Sand and Gravel Association. The organization is focused on supporting students interested in pursuing careers in the construction or aggregates industries through field trips to quarries, networking and guest lectures. The society also represents Virginia Tech and the department at conferences such as the upcoming AGG1 Academy and Expo in Houston, Texas, March 6-8, 2018.

Upcoming Events

VT-Delaware Mining and Minerals Engineering Department Tail Gate Party, September, 2017

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