# Charles Kocsis, Ph.D., P.Eng. Phone: 775-351-3692 Email: charles.kocsis@utah.edu

## EDUCATION:

* Ph.D. Degree in Mining Engineering, Norman B. Keevil Institute of Mining Engineering, University of British Columbia, Vancouver, BC, Canada, 2009.
* M.S. Degree in Mining Engineering, Department of Mining Engineering, Laurentian University, Sudbury, Ontario, Canada, 1998.
* Mining Engineering Degree (Ing.), Department of Mining Engineering, University of Petrosani, Romania, 1987.

## EXECUTIVE SUMMARY:

I am a professor in the Mining Engineering Department, College of Mines and Earth Sciences at the University of Utah, Salt Lake City. I am also a licensed Professional Engineer in the Province of Ontario (P.Eng.), Canada. I have over 25 years of mining industry-focused experience working for consulting firms in Europe and Canada (see mining-industry experience on page 14). In addition, I have 12 years of academic experience in teaching undergraduate and graduate-level mining engineering courses, while conducting research in a wide range of specialties at the Mining Engineering Department, University of Utah (2021 - Present), and at the Mining Engineering Department, University of Nevada, Reno (2012 - 2020).

On January 1, 2021, I was hired at the rank of Professor in the Mining Engineering Department, University of Utah. After one year, on January 1 2022, I was appointed department chair. From that time on, in addition to teaching and administrative duties, I was the Principal Investigator (PI) of a $460,000 research project founded by the Alpha Foundation. The objective of the project was to develop a control system to minimize spontaneous combustion in the gob, while minimizing the inflow of methane gas from the gob into the production areas. While being challenged by Covid-19 restrictions, this project was successfully completed in November 2023.

In March 2023, I spearheaded a new interdisciplinary *Mining Safety* program in collaboration with the Rocky Mountain Center for Occupational Environmental Health (RMCOEH) that will bring new perspectives in tackling tough safety and health problems in the mining industry. Classes in the *Mining Safety* program will be taught by faculty members from the mining engineering department, but unlike standard engineering courses, these will be geared towards a broad spectrum of students within the State of Utah with backgrounds ranging from industrial hygiene, emergency response, to psychology, and public health. The program is expected to begin accepting students in August 2023. Funding for the *Mine Safety* program is provided by the Utah Legislature with a cap on research and development costs of $2.4M over the next 10 years ($240,000/year).

On February 1, 2023, I was appointed by the management of Rio Tinto Kennecott as “independent reviewer” of the Resolution Copper project in Superior, Arizona. My responsibility is to review the design and construction of surface and underground structures/systems by providing a high-level, multidisciplinary engineering and scientific expertise and confirmatory analyses of engineering calculations. I am also assisting the mine design team to proactively reduce risks, identify potential design flaws, while providing alternative solutions to final designs. I strongly believe that this effort will further strengthen the Mining Engineering Department’s relationship with the management team at Rio Tinto.

As Director of the *Center for Mine Safety and Health Excellence*, Department of Mining Engineering, I am happy to announce that the Center in collaboration with Minverso developed the initial phase of a first-ever metaverse platform which includes a Health & Safety training program for the mining industry developed by using virtual reality (VR) technology. This collaborative initiative blends cutting-edge technology with academic expertise to offer our students and the mining industry a unique and immersive learning experience.

With the mining industry in positions such as Mining Consultant, Project Leader, and Senior Research Engineer, I was involved in mine feasibility level studies, detailed mining engineering projects, and research projects in areas such as: (1) mine planning, (2) mine design, (3) ventilation system design, (4) ventilation- on-demand control systems, (5) dust control in underground mines, (6) atmospheric monitoring, (7) mine climate modeling, (8) heat stress evaluation and reduction of heat-related illnesses, (9) mine cooling systems, (10) emergency response.

## PROFESSIONAL AFFILIATIONS:

1. Licensed Professional Engineer (P.Eng.) in the Province of Ontario, Canada, since 2000.
2. Member of the Society for Mining Metallurgy and Exploration Inc. (SME)
3. Member of the Society of Mining Professors (SOMP)
4. Chair of the SME’s Underground Ventilation Committee (UVC)
5. Member of the “American Exploration and Mining Association” (AEMA)

## EMPLOYMENT RECORD:

#### 2021 - Present: University of Utah, Salt Lake City, Utah, USA. Mining Engineering Department

##### Professor (January 2021 - Present)

During the spring semester of 2021 at the Mining Engineering Department, University of Utah, I developed from scratch and taught the *Mine Administration and Finance Course* (MG-EN 5170) course. During the same semester, I also co-taught the *Mining Health and Safety Management Course* (MG-EN 5350). This course provided an overview of health and safety management methods and systems in the US mining industry. Students explored various approaches to managing health & safety matters at the surface and underground mines while investigating behavior-centered safety aspects and the role of human factors with respect to close-call events, incidents, and fatal accidents. Students prepared and presented group projects on risk management concepts, the importance of safety leadership, and root-cause analysis of mining accidents.

During the fall semester of 2021, I fully restructured and taught the *Mine Ventilation and Underground Environmental Engineering* course (MG EM 5050), which in addition to lectures included nine laboratory sessions. The mine ventilation course focuses on principles of fluid mechanics, fundamentals of steady flow thermodynamics, incompressible flow relationships, ventilation network analysis, and design elements including primary & auxiliary ventilation system design, ventilation planning, mine climate modeling, mine cooling systems, atmospheric monitoring and control, ventilation automation, system optimization using advanced ventilation software, and emergency procedure and mine disaster management.

Since 2021, at the Mining Engineering Department, University of Utah, I am presently focused on developing the *Mine Ventilation Research Program*. The main objectives of this research program are: (1) build capacity in the USA by training undergraduate and graduate students to develop efficient mine ventilation systems for deep and hot mines. (2) advance the Center for Mine Safety and Health Excellence through collaboration with the mining industry and other centers, (3) establish the Diesel Particulate Matter Research Program. (3) develop efficient cooling methods and systems for deep and hot underground mines. (4) develop real-time respirable coal dust and silica dust monitoring instruments based on photoacoustic spectroscopy, (5) develop new methods and systems to reduce the exposure of mine workers to high concentrations of respirable coal dust, silica dust, and other mineral dust, (6) minimize and possibly eliminate disabling diseases generated by exposure to high concentrations of dust (coal, silica), including coal workers' pneumoconiosis, and silicosis.

As Director of the *Center for Mine Safety and Health,* I am committed to further advance the Center by developing a novel health and safety training program based on virtual reality technology (VR), augmented reality (AR), and computer-generated imagery (CGI). The Center for Mine Safety and Health will enhance the department’s sustainable impact on mine safety and health excellence in teaching and training while establishing a strong externally funded research program. An advanced health and safety training program that incorporates emerging technologies will certainly expand the reach and impact of the Mining Engineering Department on improving safety and health at the mine sites locally, nationally, and worldwide.

To achieve this, qualified faculty and research assistants in the Mining Engineering Department, University of Utah and Minverso created a research team to build, test with industry partners, and validate an innovative “Health & Safety” training program coupled with a “Mine Evacuation” training system for mine workers. The system will provide real-time guidance to underground mine workers in case of emergency and save lives while establishing a far-reaching culture of safety & health at underground mines in the USA and worldwide. For the next phase, the research team from the Mining Engineering Department and MINVERSO will be augmented with experts in psychology, education, and health sciences from the University of Utah.

**2012 - 2020**: **University of Nevada, Reno (UNR), Reno, Nevada, USA. Mining and Metallurgical Engineering Department *Associate Professor (July 2012 - Present)***

At the Mining and Metallurgical Engineering Department at the University of Nevada, Reno (UNR) I have taught undergraduate and graduate level courses as follows: (1) MINE 210 (Mining Methods), (2) MINE 444 (Mine Ventilation), (3) MINE 444L (Ventilation Laboratory), MINE 300 (Mining Industry Practicum),

1. MINE 695 (Special Problems), (6) MINE 702M (Advanced Mine Ventilation Design), and (7) MINE 702K (Advanced Health and Safety). For 2016, 2018, and, 2020 academic years, I received the *Westfall Scholar Mentor Award* from the College of Science at the University of Nevada, Reno. This award is given to top-performing graduating students with the highest-grade point average in their departments. On May 4, 2018, I received the *Mackay School Distinguished Faculty Award*. On February 25, 2020, I received the *SME’s Health & Safety Research, and Educational Excellence Award* (Phoenix, Arizona).

Between 2012-2020, while at the Mining and Metallurgical Engineering Department, University of Nevada-Reno, I conducted research as Principal Investigator (PI) and Co-Principal Investigator (Co-PI) through grants and sponsored projects totaling over $3.5M, which were funded by federal agencies, private research organizations, and the mining industry, including: (a) The National Institute for Occupational Safety and Health (NIOSH), (b) The Alpha Foundation, (c) Newmont Gold Corporation, (d) Freeport McMoRan. My research work is focused on providing solutions to surface and underground mines for current operating needs as well as long-term demands, such as: (1) dust control in coal and metal mines, (2) diesel particulate matter mitigation, (3) health and safety problems related to hot and humid mines, (4) heat stress analysis through advanced thermal comfort models, (5) cooling systems, (6) development of real-time coal dust and silica dust monitoring instrumentation, (7) development of health and safety training systems based on emerging technology (8) battery-powered mining equipment.

#### 1999 - 2012: CanmetMINING - Mine Ventilation Group, Sudbury, Ontario, Canada.

##### Senior Research Engineer (September 1999 - July 2012)

With CanmetMINING, I have been involved in engineering projects and research studies in areas such as:

(a) climatic modeling for deep and hot mines, (b) underground environmental control, (c) contaminant monitoring, (d) ventilation system design, and (e) ventilation automation. Designed and optimized primary and auxiliary ventilation systems for mines employing conventional extraction methods and for mines benefiting from various levels of process automation. Managed and conducted research work in areas such as: (1) mine ventilation optimization, (2) heat stress analysis, (3) climatic modeling, and (4) ventilation-on-demand control systems. During my Ph.D. studies, I developed a new mine ventilation design method based on “life-cycle” air volume demand requirements, which were generated by means of discrete-event mining process simulation techniques. As a team member, I also worked on the development of CANMET’s mine ventilation software package (e.g. 3D-CANVENTTM).

#### 1998 - 1999: Golder Associates, Sudbury, Ontario, Canada.

##### Mining Engineer (June 1998 - September 1999)

As project leader and team member, I was involved in engineering projects and mine feasibility level studies in areas such as: (a) mine ventilation design, (b) geotechnical modeling, (c) mine planning, (c) reserve estimation, and (d) underground excavations. As a team member, I assisted in the development of Golder’s blast design software package.

#### 1997 - 1998: H.A. Simons Ltd. - McCreedy East Mining Group, Levack, Ontario, Canada.

##### Mining Engineer (April 1997 - May 1998)

Worked on the development of a simulation model for Coleman/McCreedy East Mine’s material handling system using a mining process simulator (e.g. AutoModTM) aiming to improve the mine’s Kiruna truck haulage system, its hoisting system, as well as the mine’s surface material movement practices by means of a discrete-event mining process simulation software.

#### 1996 - 1998: Laurentian University - Department of Mining Engineering, Sudbury, Canada.

##### Research Assistant (M.A.Sc.) – Department of Mining Engineering (1996 - 1998)

Analyzed the effects of air density (ρ) variation along the vertical and horizontal airways of a large and deep metal mine by means of ventilation and climatic modeling techniques. Identified and quantified the contributing factors in respect to air density (ρ) variation, such as the heat generated by auto-compression, and the heat transferred into the ventilating air from strata, mining equipment, and production blasting. Developed a new method to display contaminant distribution (CO, CO2) throughout an underground mine generated by a potential fire. Established emergency response protocols in case of underground mine fires.

#### 1988 - 1995: S.C. MINESA Consulting SA, Cluj-Napoca, Romania.

##### Project Leader (September 1988 - August 1995)

Managed pre-feasibility and feasibility level studies. Conducted environmental impact assessments for surface and underground operations (coal, metal, non-metal). As a team member, performed engineering work in areas such as: (a) production planning, (b) equipment selection, and (c) detailed engineering design for surface and underground structures. Conducted project evaluation and investment analysis based on key production indicators and market demand. Performed anemometry-based mine ventilation surveys.

# ACADEMIC EXPERIENCE

On January 1, 2021, I was hired at the academic rank of Professor in the Mining Engineering Department, University of Utah, and appointed Director of the *Center for Mine Safety and Health*. In addition, on Januray1, 2022, I was appointed department chair. Between 2021 - 2022, as a Professor in the Mining Engineering Department, at University of Utah, I published 3 journal papers, 2 peer-reviewed conference papers, and delivered presentations at invited meetings and workshops (see journal publications, page 9).

While with the mining industry and academia, I published 28 journal papers, 34 peer-reviewed conference papers, and delivered over 40 technical presentations at invited meetings and workshops. Through consulting and auditing work, I prepared and delivered over 30 professional reports to the mining industry, government organizations, and consulting firms (see Industry Experience).

With respect to Department service, I would like to mention that I was the Faculty Advisor of the *John Mackay Club* (JMC), which is the student chapter of the Society for Mining Metallurgy and Exploration (SME). As faculty advisor of the JMC, my services include: (**1**) guiding the mining engineering students on their senior field trips, (**2**) organizing and ensuring students’ attendance at the SME’s annual conferences, (**3**) advising and supervising the students during SME’s annual conferences, (**4**) organizing industry presentations, and (**5**) provide advice and support on fundraising activities. With respect to department service, I am a member of the department’s *Personnel Committee* and a member of the department’s *Tenure Committee*.

As service to the College of Science and to the University, I was a member of professional committees and outreach organizations, such as: (**a**) *The College of Science Personnel Committee*, which is made up of representatives of all the academic programs to evaluate applications for promotion and tenure, (**b**) Judge for the *Graduate Students Association Awards Program*, and (**c**) Member of the *Nevada Mining and Material Sector Council*, which focuses on providing training, and educational programs to improve safety and health at the surface and underground mines in the state of Nevada.

### Teaching Experience:

### MG-EN 5170: Mine Administration and Finance (Univ. of Utah - Undergraduate)

### MG-EN 5050: Mine Ventilation and Underground Environment Control (Univ. of Utah - Undergrad.)

### MG-EN 5350: Mining Health and Safety Management (Univ. of Utah - Undergraduate)

1. MINE 210: Mining Methods - Surface and Underground (UNR - Undergraduate)
2. MINE 300: Mineral Industry Practicum (UNR - Undergraduate)
3. MINE 444: Mine Ventilation (UNR - Undergraduate)
4. MINE 444L: Mine Ventilation Laboratory (UNR - Undergraduate)
5. MINE 695: Special Problems in Mining (UNR - Graduate)
6. MINE 702M: Advanced Mine Ventilation Design (UNR - Graduate)
7. MINE 702K: Advanced Mine Health and Safety (UNR - Graduate)
8. MINE 702MO: Advanced Mine Ventilation Design - Online Course (UNR - Graduate)
9. MINE 795: Comprehensive Examination (UNR - Independent Study)
10. MINE 796: Professional Paper (UNR - Independent Study)
11. MINE 797: Thesis (UNR - Independent Study)
12. MINE 799: Dissertation (UNR - Independent Study)
13. MG-EN 5170: Mine Administration and Finance (University of Utah - Undergraduate)
14. MG-EN 5350: Mining Health & Safety Management (University of Utah - Undergraduate)
15. MG EN 5050: Mine Ventilation and U/G Environment Control (University of Utah - Undergraduate)
16. MG EN 4990: Mining Seminar (University of Utah - Undergraduate)
17. MG EN 7800: Graduate Seminar (University of Utah - Graduate)
18. MG EN 6970: Thesis Research (University of Utah - Graduate)

### Grant Activity:

Between 2021 - 2022, as Professor and Principal Investigator (PI) in the Mining Engineering Department, University of Utah, I was involved in a $460,000 research project funded by the Alpha Foundation “*Application of Pressure Balancing Techniques at the West Elk Coal Mine*”. Pressure balancing is a ventilation technique that can be used to reduce or eliminate the egress of oxygen to the mine gob (in-gassing), thus reducing the risk of spontaneous combustion. At the same time, pressure balancing can also be used to reduce the risk of methane seeping into the mine ventilation circuits from the gob (out-gassing), when the barometric pressure changes on the surface. Two pressure balancing chambers have been constructed at the West Elk Mine, Colorado, operated by the Mountain Coal Company (MCC), one in a mined-out area, and another close to the active area, near a longwall mine gob. Each chamber is equipped with an isolation stopping, safety doors, a nitrogen injection system, and a set of pressure and environmental monitoring sensors. Thus far, several pressure balancing tests for different ventilation conditions have been conducted to assess the ability of the chambers to hold a pressure differential between the gob and the chamber, and between the chamber and the entry in order to avoid in-gassing and out-gassing.

Between 2012 - 2020, as an Associate Professor at the University of Nevada, Reno, I have been conducting research as Principal Investigator (PI) and Co-Principal Investigator (Co-PI) through grants and sponsored projects totaling over $3.5M, funded by federal agencies, private organizations, and the mining industry:

1. “*Assessing, Modeling, and Cooling Underground Workings in Deep and Hot Mines*”, $1,250,000:

#### Principal Investigator (PI) 5-year project (Aug. 31, 2015 - Sep. 20, 2019), Funded by NIOSH:

The main objectives of this 5-year and 1.25M research study were: (**1**) identify empirical or rational heat stress indices, which will protect workers in deep hot underground mines, (**2**) quantify the heat load at the participating mines, (**3**) develop ventilation-thermal-humidity (V-T-H) models to evaluate transient heat transport processes, (**4**) quantify the thermal flywheel effect (TFE) and demonstrate its importance when predicting work conditions in future underground mines, (**5**) provide mine cooling strategies and develop efficient ventilation and refrigeration systems for deep and hot mines in the USA. Climatic monitoring units were installed at the Turquoise Ridge mine (Barrick) and Leeville Mine (Newmont) to quantify the heat generated from sources such as: strata, auto-compression, mining equipment, and blasting. Developed a program to assess and compare the heat stress indices at various underground mines based on an advanced

*thermal comfort* model. Developed and applied mathematical models to assess the sweat rate (SW), skin wetness (w), and work duration limits (WDL) for the underground workers as a function of their metabolic rate (M), clothing, and underground climatic conditions. Collected ventilation and climatic data at the participating mines (Barrick & Newmont) to quantify the *thermal flywheel effect* and validate the V-T-

H. Funded and graduated 12 students (4 Ph.D. + 8 MS) with advanced degrees in mine climate control.

1. “*Development of a Personal Real-Time Respirable Coal Dust and Respirable Silica Dust Monitoring Instrument Based on Photoacoustic Spectroscopy*”, $370,960: **Principal Investigator (PI) 3-year project (Sep. 15, 2019 – Sep. 14, 2022), Funded by NIOSH:**

The main objective of this project is to design, fabricate, and test a new *real-time personal coal and silica dust* (RTPCSD) monitoring instrument based on photoacoustic spectroscopy. The hardware components and associated software will enable the unit to continuously measure concentrations of coal dust and silica dust in underground coal mines, metal/nonmetal mines, as well as surface operations. As opposed to the mass-based and filter-based units, the RTPCSD device will be constructed on optical design principles, which will enable the instrument to sequentially measure coal dust and silica dust concentrations from the same air sample. In addition, the RTPCSD unit will have the ability to operate unattended and without any maintenance for a prolonged period of time. Through continuous dust exposure readings, the RTPCSD instrument will help the mine operators immediately identify high transient dust concentrations, locate their sources, and determine the efficiency of the dust control methods and systems. Due to its ability to operate unattended, this instrument could be installed independently or in a network configuration throughout the mine, and could be easily connected to the mine’s existing communication infrastructure.

1. “*Respirable Coal Mine Dust (RCMD) Research: Characterization, Deposition, Monitoring, and Mitigation of RCMD and Capacity Building for Mine Health and Safety*”, $1,250,000: **Co-Principal Investigator (Co-PI), 5-year project (Sep. 15, 2019 – Sep. 14, 2024), Funded by NIOSH:**

The objective of this 5-year and 1.25M research project is to investigate the characterization, deposition, monitoring, and mitigation of respirable coal mine dust (RCMD). Firstly, the RCMD characterization including size, shape, mineralogy, and bio-accessibility will be investigated. The investigators will utilize an innovative *mobile aerosol lung deposition apparatus* to study the relationship between RCMD characteristics and respiratory deposition. Secondly, comprehensive research studies will be conducted in order to understand the interaction of the particles with water droplets and the ways that capturing- efficiency can be improved through modifications of water droplet characteristics. Thirdly, the accuracy of particle number-concentration based RCMD monitoring systems will be assessed and their effectiveness will be compared with the mass-based monitoring method experimentally. In addition, a predictive model will be developed to identify and quantify the relationships between source, concentration, characterization, and respiratory deposition of RCMD. Research work represents a geographically diverse collaborative effort between four mining engineering schools: (1) New Mexico Institute of Mining and Technology, (2) University of Nevada-Reno, (3) Penn State University, and (4) Medical School at the University of Texas.

1. “*Development of a Real-Time Diesel Particulate Matter (DPM) Monitoring Instrument*”, $50,000:

#### Principal Investigator (PI), 2-year project, Funded by Newmont Gold Corporation:

In collaboration with the Physics Department, a real-time diesel particulate matter (DPM) monitoring instrument was developed and tested. This instrument selectively measures the black carbon aerosol component of the DPM to avoid cross-sensitivity to dust. Unlike any other current sampling unit, which uses a filter to collect DPM, this real-time instrument is based on photoacoustic measurements of aerosol light absorption. This advanced technology makes this unit lightweight and reliable in a hot, humid, and dusty environment. Real-time DPM measurements allow for immediate feedback to mine operators in order to identify the conditions that give rise to high DPM concentrations so that effective operational measures can be put in place to achieve compliance with MSHA’s exposure standards.

1. “*Development of an Advanced Real-Time Respirable Coal Dust Monitoring Instrument Based on Photoacoustic Spectroscopy*”, $173,680: **PI, 2.5-year project, Funded by the Alpha Foundation**:

This study was awarded on June 16, 2017, by the Alpha Foundation. The objective of this research project was to design, fabricate, and test a new real-time personal coal dust (RTPCD) monitoring instrument based on optical principles. This will enable the underground coal mines to continuously measure and monitor respirable coal dust in real-time. The RTPCD instrument is based on photoacoustic spectrometry principles, which will empower the unit to operate unattended for a prolonged period of time. This technology allows the instrument to be built as an intrinsically safe unit, which can be used in hot, humid, and dusty environments. Through continuous dust concentration readings, the RTPCD unit will help the mines to immediately identify and measure high “transient” coal dust concentrations and pinpoint their sources.

1. “*Development of a Novel Health and Safety Training Program at the Mining Engineering Department based on Virtual Reality (VR) Technology*”, $120,000: **Principal Investigator (PI), 3-year project, funded by Newmont Gold Corporation**:

The main goal of this project is to develop a novel virtual reality (VR) simulator, which will have the ability to assess and analyze in real-time the reactions of the mine personnel during normal work conditions, as well as during an emergency situation. The objectives of this research project are: (1) Train and test the underground workers, (2) Increase the confidence of the underground workers by preparing them to react to various hazards and contaminants in real-time, (3) Help the mine operators to prepare a disaster management response program, (4) Provide an infrastructure to the mine workers and engineering staff to discuss and address health and safety hazards, (4) Provide transparent advertising of sustainable mining practices to the public and stakeholders.

1. “*Upgrading the Pilot Ventilation-On-Demand Physical Model*”, $50,000: **Principal Investigator (PI), 2-year project, funded by Newmont Gold Corporation**:

Ventilation-on-demand (VOD) is a relatively new technology, which besides improving safety and health, can also reduce energy consumption in underground mines, and consequently their carbon footprint. To improve signal processing and analyze contaminant distribution (e.g. CO2, NO, NO2, CH4) as a function of variable airflow delivery regimes, this pilot VOD control system was upgraded during 2016-2017. The upgrade adds a new development heading to the network, new automated airflow regulators, a new contaminant sensing system, airflow & differential pressure sensors, and a new ventilation control program developed in C++. Students can now develop their own ventilation control algorithm using a general-purpose programming language, and quantify the economic and environmental benefits of a potential VOD control system at an underground mine using a ventilation software package (e.g. VentsimTM).

1. “*2016 SME Academic Career Development Award*”, $300,000: **Funded by Freeport McMoRan Inc.**:

The SME career development grant is a 3-year, $300,000 award funded by Freeport McMoRan to support mining engineering faculty to better participate in activities such as research, publication, and professional service to help him obtain tenure and promotion at the University of Nevada, Reno. The award was presented by the Chair of the SME Grant Evaluation Committee, on February 17, 2017.

### Service:

##### Department, College, and University

* Director - Ph.D. Program at the Mining and Metallurgical Engineering Department.
* Member of the Personnel Committee at the Mining & Metallurgical Engineering Department.
* Member of the Personnel Committee – College of Science, University of Nevada, Reno.
* Faculty Advisor of the John Mackay Club (JMC).
* Grant Reviewer for the Graduate Students Association (GSA).
* Chair - SME Executive Underground Ventilation Committee.
* Invited Internal Project Reviewer for CDC-NIOSH.

##### Mining Industry and Community

On September 18, 2013, I was appointed by the Director of the Nevada Department of Employment, Training, and Rehabilitation (DETR) to serve as a member of the *Mining and Material Sector Council*, as part of the Nevada Governor’s Workforce Investment Board (GWIB). The *Mining and Materials Sector Council* was created to support the Governor’s Workforce Investment Board to identify workforce needs and provide job training, and educational programs to the mining industry in Nevada. As a council member, my responsibilities are: (1) Identify and establish internships and scholarships to support institutions within the Nevada System of Higher Education (NSHE), (2) Improve funding for the NSHE institutions to better meet the needs of our students and fulfill the institutions’ mission of teaching, research, and services, (3) Improve safety and health at the surface and underground mines, and the overall quality of life of the mine workers in the state of Nevada.

**Graduate Students** (Ph.D. and M.S.)

#### Committee Chair and Principal Advisor (UNR & University of Utah):

* + Maurice N. Sunkpal, MS Degree in Mining Engineering, December 2015, Thesis title: *Assessing Thermal Comfort in Deep and Hot Underground Mines.* University of Nevada-Reno.
  + Karena Carpenter, MS Degree in Mining Engineering, May 2016, Professional paper: *Investigating the Importance of Climatic Monitoring and Modelling in Deep and Hot US Mines*. UNR.
  + Pedram Roghanchi, Ph.D. Degree in Geo-Engineering, May 2017, Dissertation title: *Managing and Controlling the Thermal Environment in Underground Metal Mines*. University of Nevada-Reno.
  + Laura O’Connor, MS Degree in Mining Engineering, May 2018, Thesis title: *Investigation into the Development of Thermal Management Policies for Underground Metal Mines in the United States*.
  + August Greth, MS Degree in Mining Engineering, May 2018, Thesis title: *Evaluating Mine Cooling Systems and Mine ventilation Strategies to be applied in Deep and Hot US Mines*. UNR.
  + Charles McArthur, MS Degree in Mining Engineering, May 2018, Professional paper: *Development of efficient underground ventilation systems for underground operations where selective mining methods are employed*. University of Nevada-Reno.
  + Marcelo Teixeira, MS Degree in Mining Engineering, May 2019, Thesis title: *Reducing the Heat Load in Underground Mines by Means of New Technologies, and Development of Efficient Cooling Methods and Systems for Hot and Humid Underground Mines*. University of Nevada-Reno.
  + Jacob Parrish, MS Degree in Mining Engineering, May 2019, Thesis title: *Development of a Novel Health & Safety Method to Prevent Heat-Related Illnesses in Hot and Humid Underground Mines Using Commercially Available Continuous Health Monitoring Equipment*. UNR.
  + Ralston Pedersen, MS Degree in Mining Engineering, May 2019, Thesis title: *Development, Application, and Validation of the Real-Time Coal Dust Monitoring Instrument*.
  + Kyle Scalise, Ph.D. Degree in Geo-Engineering, May 2020, Dissertation title: *Improving Health and Safety at Surface and Underground Mines by Implementing Emerging Technologies Coupled with Geotechnical and Climatic Modeling*. University of Nevada-Reno.
  + Jon Fox, Ph.D. Degree in Geo-Engineering, August 2020, Dissertation title: *Development of Renewable Energy-Based Cooling Systems for Deep and Hot Underground Mines*. UNR.
  + Natanna Nunes de Oliveira, August 2023, MS Degree in Mining Engineering, Thesis: *Application of Pressure Balancing Techniques at a Western Underground Coal Mine*, University of Utah.

#### Committee Member and Advisor:

* + Ebrahim Karimi Tarshizi, Ph.D. Degree in Geo-Engineering, December 2014, Dissertation title:

*Multiple Discrete-Event Simulation and Animation Models to Assist Modern Mining Operations.* University of Nevada-Reno.

* + Virginia Ibarra, MS Degree in Mining Engineering, May 2015, Thesis title: *Discrete-Event Simulation and Animation for a Complex Open-Pit Mine, Marigold Mine, Nevada.* UNR.
  + Ivan Vazquez-Rubio, MS Degree in Mining Engineering, December 2016, Thesis title: *Numerical Model Studies of Enhanced Geothermal Systems.* University of Nevada-Reno. UNR.
  + William Kofi Asante, Ph.D. Degree in Geo-Engineering, May 2017, Dissertation title: *Dynamic Atmospheric Signal Analysis for Improving Mine Safety and Health*. University of Nevada-Reno.
  + Rushikesh Battulwar, MS Degree in Mining Engineering, December 2018, Thesis title: *Flight Path Planning and Optimization for High-Resolution Imaging in Open Pit Mines by Unmanned Aerial Vehicles (UAV)*. University of Nevada-Reno.
  + Jeffrey Olson, MS Degree in Metallurgical Engineering, December 2018, thesis title: *The Prediction of Gold Recovery by Carbon-in-Leach Cyanidation using Visible Near-Infrared (VNIR) Spectroscopy of Pulverized Ore Samples from the Cortez Hills Underground Mine.* UNR.
  + Chao Lu, Ph.D. Degree in Geo-Engineering, August 2019, Dissertation title: *The Effects of Thermal History of the Strata on Temperature Variation along Underground Airways*. UNR.
  + David Shaw, Ph.D. Program (Ongoing) in Geo-Engineering at the Department of Geological Engineering at the University of Nevada, Reno. Dissertation: *Ground Surface Observations in Evaluation Shallow Stress Fields in Granitic Rock Masses*. University of Nevada-Reno.
  + Daniel J. Stinnette, Ph.D. Program (Ongoing) in Mining Engineering at the Mining and Minerals Engineering Department of Virginia Tech, Blacksburg, VA. Dissertation: *An Innovative Online Platform for the Education of Mine Ventilation Professionals*. Virginia Tech.

### International Collaborative Research

During the fall semester of 2019, I was granted a 6-month sabbatical leave (Jul. 1 - Dec. 31, 2019). In the course of this time frame, I conducted research with faculty from Lulea Technical University in Sweden and mining professionals from Epiroc (Sweden) and Kittila Mine (Finland), while working on the *Sustainable Intelligent Mining System*s (SIMS) project funded by Epiroc, Agnico Eagle, LKAB, KGHM Cuprum, ABB, and Ericsson.

With respect to the SIMS project, I conducted research on battery-powered mining equipment, zero-emissions underground material handling systems, process automation, underground communication systems, and the development of autonomous mining systems, which were part of Work Package #6 - *Battery Powered Mining Equipment*, and Work Package #3 - *Underground Communication and Positioning Systems*.

An important objective of this collaborative research project is to test, evaluate, and demonstrate an advanced material handling system developed by Epiroc (Sweden) for underground metal and nonmetal mines. Emerging technologies have the ability to remove diesel particulate matter (DPM) and toxic gases from production stops and reduce noise while reducing the mines' energy consumption through the use of battery-powered mining equipment and advanced material handling systems. Battery-powered mining equipment and zero-emission material handling systems can also represent a platform for the demonstration of mining process automation solutions where mining equipment interact with each other, and with tags and sensors used by mine personnel through an advanced communication system.

Another important objective of Work Package #6 is to re-design the ventilation system for a DPM-free underground operation and quantify the cost benefits resulting from the mine’s ventilation systems, as a result of reduced air volumes required by battery-powered equipment as opposed to diesel equipment. It is mentioned that equipment testing, process demonstration, data analysis, and battery/equipment design work were also performed at Epiroc’s underground new testing facility in Orebro (Sweden) and at the Kittila Mine (Finland) operated by Agnico Eagle. Knowledge and experience gained through this collaborative research project will be transferred to many underground mines in the states of Utah, Nevada, and across the USA.

# SELECTED PUBLICATIONS:

# Journal Papers (\* Faculty, # Student, μ Industry Professional)

1. Taylor, S.J. **#**, Nascimento, P. **#**, Arnott, W.P.\*, Kocsis, K.C.\*, *Real-time Photoacoustic Measurements of Mass Concentration of Respirable Crystal Silica Dust: Theory*. Mining, Metallurgy & Exploration Journal, July 31, 2022. <https://doi.org/10.1007/s42461-022-00657-2>
2. Nascimento, P. **#**, Taylor, S.J. **#**, Arnott, W.P.\*, Kocsis, K.C.\*, Wang, X.L.\*, Firouzkouhi, H.\*, *Development of a Real-Time Respirable Coal Dust and Silica Dust Monitoring Instrument Based on Photoacoustic Spectroscopy*. Mining, Metallurgy& Exploration Journal, August 20, 2022.

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1. Halim, A.\*, Loow, J., Johansson, J.μ, Gustafsson, J.μ, van Wageningen, A. μ, Kocsis, K.C.\*, *Improvement of Working Conditions and Opinions of Mine Workers when Battery Electric Vehicles (BEVs) are Used Instead of Diesel Machines – Results of Field Trial at the Kittila Mine, Finland,* Published in the Mining, Metallurgy & Exploration Journal, October 25, 2021.

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1. Scalise, K.A.**#**, Keefner, J.**μ**, **Kocsis, K.C.\***, *Geotechnical Modeling at Round Mountain, Kinross*, International Journal of Geoengineering Case Histories, Jan. 2020.
2. Scalise, K.A.**#**, Keefner, J.**μ**, Ali, T.**μ**, **Kocsis, K.C.\***, *Assessing Blasting Techniques in Vibration Sensitive areas at Round Mountain, Kinross to Enhance Blasting Criteria*, SN Applied Sciences Journal, May 2020.
3. Scalise, K.A.**#**, Teixeira M.B.**#**, **Kocsis, K.C.\***, *Managing Heat in Underground Mines: The Importance of Incorporating the Thermal Flywheel Effect into Climatic Modeling*, SME Mining, Metallurgy & Exploration Journal, Feb. 2020.
4. Scalise, K.A.**#**, **Kocsis, K.C.\***, *Utilizing Nonlinear Autoregressive with Exogenous Input Neural Networks to Evaluate the Thermal Flywheel Effect along Intake Shafts at Nevada Mines*, Accepted by the SME Mining, Metallurgy & Exploration Journal, Apr. 2020.
5. Scalise, K.A.**#**, Teixeira M.B.**#**, **Kocsis, K.C.\***, Robertson, K.,**μ** *Utilization and Implementation of Geothermal Systems and Ground Source Heat Pumps for Underground Mine Cooling*, Published in the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Journal, May 2018.
6. Fox, J. **#**, Greth, A.**#**, **Kocsis, K.C.\***, *Analyzing the Health and Cost Benefits of Utilizing Electric Engines Versus Diesel for Equipment Fleets in Hot Underground Mines*, Published in SME Mining Engineering Journal, Aug. 2018, Vol. 70, No. 8, pp.16-27. <http://me.smenet.org/abstract.cfm?preview=1&articleID=8478&page=16>
7. **Kocsis, K.C.\***, *Introducing a New Mine Ventilation Design Method by Integrating Discrete-Event Mining Process Simulation and Ventilation Simulation*. Transactions of the Society for Mining, Metallurgy, and Exploration, Vol. 344, 2018, pp.48-61. <https://doi.org/10.19150/trans.8748>
8. Roghanchi, P.**#**, **Kocsis, K.C**.**\***, *Quantifying the Thermal Damping Effect in Underground Vertical Shafts using the Nonlinear Autoregressive with External Input (NARX) Algorithm*. Published in the International Journal of Mining Science and Technology, Jun. 2018, Available online on Jun. 19, 2018. <https://www.sciencedirect.com/science/article/pii/S2095268618301071>
9. Sunkpal, M.**#**, Roghanchi, P. **#**, **Kocsis, K.C**.**\***, “*A Method to Protect Mine Workers in Hot and Humid Environments*”. University of Nevada, Reno. Published in the Safety and Health at Work Journal, September 2018, pp. 149-158. <http://dx.doi.org/10.1016/j.shaw.2017.06.011>
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12. Roghanchi, P.**#**, **Kocsis, K.C.\***, Sunkpal, M.**#**, *Sensitivity Analysis of the Effect of Airflow Velocity on the Thermal Comfort in Underground Mines*. University of Nevada, Reno. Published in the Journal of Sustainable Mining, March 28, 2017. <http://dx.doi.org/10.1016/j.jsm.2017.03.005>
13. Roghanchi, P.**#**, **Kocsis, K.C.\***, *Improving the Climatic Conditions in the Development and Production Workings of Hot Underground Mines by Redesigning their Auxiliary Ventilation System - A Case Study*. Published in the International Journal of Mining and Mineral Engineering, November 5, 2017, Vol. 8, No. 4, pp.280-293. <https://doi.org/10.1504/IJMME.2017.087965>
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15. **Kocsis, K.C.\***, *Have Emerging Technologies Reached the Point where Diesel Particulate Matter (DPM) can be removed from Underground Mines?* Published in SME Mining Engineering Journal, October 2017, Vol. 69, No. 10, pp. 54-60. <https://doi.org/10.19150/me.7808>
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17. Tarshizi, E**#**., **Kocsis K.C.\***, Taylor D.**\***, *Advanced Approach to Assess and Improve Underground Mine Evacuation Using Discrete-Event Simulation and Animation*. Published in the International Journal of Mining and Mineral Engineering, May 10, 2016, Volume 7, No. 2, pages. 170-179. <https://doi.org/10.1504/IJMME.2016.076500>
18. Li Gary, **Kocsis K.C**., Hardcastle S.G., *Sensitivity Analysis on Parameter Changes in Underground Mine Ventilation Systems*, Published in the Journal of Coal Science & Engineering, China Vol. 17, No. 3, Sep. 2011, pp 251-255, DOI 10.1007/s12404-011-0305-z.
19. **Kocsis K.C.**, Hardcastle S.G., Eastick D., *Environmental and Ventilation Benefits for Underground Mining Operations Using Fuel Cell Powered Production Equipment*, Published in the Canadian Institute of Mining Metallurgy and Petroleum (CIM) Journal Vol. 100, No. 1105, Nov. 2007. Note: Publication received the *HATCH Global - Best Paper Award for the Year 2007, Toronto, Canada*.
20. **Kocsis K.C.**, Hardcastle S.G., Eastick D., *Environmental and Ventilation Benefits for Underground Mining Operations Using Fuel Cell Powered Production Equipment*, Published in the Canadian Institute of Mining Metallurgy and Petroleum (CIM) Journal Vol. 100, No. 1105, Nov. 2007. Note: Publication received the *HATCH Global - Best Paper Award for the Year 2007, Toronto, Canada*.
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25. **Kocsis K.C.**, *New Ventilation Design Criteria for Underground Metal Mines Based Upon the Life-Cycle Airflow Demand Schedule*, Ph.D. Dissertation, University of British Columbia, Department of Mining Engineering, Aug. 2009, Vancouver, BC, Canada.
26. **Peer-Rewired Conference Papers** (\* Faculty, # Student, μ Industry Professional)
27. Kocsis, K.C.\*, Calizaya F\*., Johnson, J\*, Dias, T#., Nunes N#., Lindgren μ, E., Atchley, G μ., Poulos, J μ. “Application of Pressure Balancing Techniques at the West Elk Coal Mine”. Published in the Proceedings of the 19th US/North American Mine Ventilation Symposium, Jun. 17-22, 2023, Rapid City, South Dakota, USA.
28. **Kocsis, K.C.\***, Parrish, J.**#**, Teixeira, M.B. **#**, Scalise, K.A**#**., *Reducing Heat-Induced Health and safety Problems in Underground Metal Mines by Means of New Technologies*. Published at the 17th North American Mine Ventilation Symposium, April 28 - May 1, 2019, Montreal, Quebec, Canada.
29. Fox, J. **μ**, **Kocsis, K.C. \***, *Development of Practical Renewable Energy Efficient Cooling Systems and Strategies*. Published at the 17th North American Mine Ventilation Symposium, April 28 - May 1, 2019, Montreal, Quebec, Canada.
30. **Kocsis, K.C. \***, Roghanchi, P. **#,** Teixeira M.B. **#**, Parrish, J. **#**, Scalise, K.A. **#**, *Sensitivity Analysis on Major Heat sources and Evaluation of Cooling Systems to Provide Adequate Work Conditions in Underground Metal Mines*, Published at the 8th International Multidisciplinary Symposium, SIMPRO 18, University of Petrosani, October 11-13, 2018, Petrosani, Romania.
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32. Roghanchi, P.**#**, **Kocsis, K.C.\***, Greth, A.**#**, Powell, A.**μ**, *Optimizing the Auxiliary ventilation Systems to Mitigate Heat and Gasses in Underground Metal Mines - A Case Study*. Published in the Proceedings of the 16th US/North American Mine Ventilation Symposium, Jun. 17-22, 2017, Golden, CO, USA.
33. Roghanchi, P.**#**, **Kocsis, K.C.\***, Greth, A.**#**, Powell, A.**μ**, *Evaluation of the Atmospheric and Underground Environmental Conditions by Means of Continuous Climatic Monitoring Systems – Lessons Learned*. Published in the Proceedings of the 16th US/North American Mine ventilation Symposium, Jun. 17-22, 2017, Golden, CO, USA.
34. Tarshizi, E. **#**, **Kocsis, K.C. \***, *Using Discrete-Event Simulation and Animation to Identify the Optimal Size and Locations of Mine Refuge Chambers*. Published at Applications of Computers and Operations Research in the Mineral Industry (APCOM), May 23-27, 2015, Fairbanks, Alaska, USA.
35. Roghanchi, P.**#**, Sunkpal, M.**#**, **Kocsis, K.C.\***, *Understanding the Human Thermal Balance and Heat Stress Indices as they Apply to Deep and Hot US Mines*. Published at the 15th North American Mine Ventilation Symposium, Mining and Minerals Engineering, Jun. 20 - 25, 2015 Virginia Tech, Blacksburg, VA, USA.
36. Carpenter, K.**#**, Roghanchi, P.**#**, **Kocsis, K.C.\***, *Investigating the Importance of Climatic Monitoring and Modelling in Deep and Hot US Underground Mines*. Published at the 15th North American Mine Ventilation Symposium, Mining and Minerals Engineering, June 20-15, 2015, Virginia Tech, Blacksburg, VA, USA.
37. Hardcastle S.G.**μ**, **Kocsis K.C.\***, Lyle G.**μ**, Bullock K.**μ**, Dasys A.**μ**, Allen C.**μ**, and Bartch E.**μ**: *Assessing Environmental Changes and Recognizing Activity within a Ventilation-On-Demand (VOD) System*. Published in the Proceedings of the 14th U.S. Mine Ventilation Symposium, June 17-20, 2012. University of Utah, Mining Engineering, Salt Lake City, UT, pp 499-508.
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41. Hardcastle S.G., **Kocsis K.C.**, Li G., and Hortin K., *Analyzing Ventilation Requirements And The Utilization Efficiency Of The Kidd Creek Mine Ventilation System*, Proceedings of the 12th U.S./N. American Mine Ventilation Symposium, June 2008, Reno, U.S.A., 27-36, Editor: K. Wallace, ISBN 978-0-615-20009-5.
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60. **Kocsis, K.C.**, *Computer Simulation of Ventilation Conditions for Automated Underground Metal Mines*, M.A.Sc. Thesis, Faculty of Graduate Studies, Department of Mining Engineering, Laurentian University of Sudbury, June 1999, Sudbury, ON, Canada.
61. **INDUSTRY EXPERIENCE** (Selected Projects):

#### Ventilation Audit at Dundee Precious Metals, Chelopech, Bulgaria, European Union, Jan. 2020.

Performed an anemometry/barometry ventilation survey at the Dundee Precious Metals mine in Chelopech, Bulgaria, EU to determine the efficiency of the mine’s ventilation system and ensure that the required air volumes are delivered to the production workings cost-effectively. Collected ventilation and climatic data to quantify the airflow distribution, pressure losses, and determine the quality of the ventilating air while assessing compliance with a local regulatory requirement. Determined the operating duties and the efficiency of the mine’s primary fans. Determined the total heat load of the mine, and the makeup of the mine’s total heat load (%) from heat sources such as: auto-compression, mining equipment, backfill, and groundwater. Updated and validated the ventilation model based on measured ventilation and climatic parameters. Quantified the natural ventilation pressure (NVP) of the mine and determined the influence of NVP on the operating characteristics of the main surface fans. Provided recommendations to improve the efficiency of the ventilation system. Presented recommendations for the development of a localized/spot cooling system in order to provide adequate work conditions in the production stopes during summer.

#### Ventilation Optimization at the Eagle Point Mine, Rabbit Lake Operations - Project Leader, CAMECO Corporation, Saskatoon, Saskatchewan, Canada, Mar. 2012.

Conducted an air volume and pressure survey on the mine’s primary intake and exhaust fans to determine their operating duties. Performed barometric pressure and anemometry-based air volume measurements along the vertical intake and exhaust raises (FAR/RAR) and throughout the mine to establish the airflow distribution throughout the mine’s primary ventilation system. Identified and corrected inefficiencies, and validated the ventilation model based on measured fan operating characteristics, pressure loss (frictional & shock) and air volume measurements. The validated model was used for future ventilation planning and infrastructure design (FAR/RAR), as a deeper orebody is being developed at the Eagle Point Mine.

#### Development, Testing and Evaluation of the Modular Thermal Transfer Unit (MTTU) at Vale’s Stobie

**Mine, Sudbury, Canada, Feb. 2012.**

Developed, tested, and assessed a mobile modular thermal transfer unit (MTTU) at Vale’s Stobie mine, while developing a novel method for evaporating and freezing mine water in climates where seasonal freezing occurs. The modular thermal transfer unit can be used to cool the mines’ intake air during summer while achieving the following benefits: (a) Reduce ventilation operating costs for cooling the mines’ intake air during summer using renewable energy harvested during winter, and (b) Construct the MTTU such that it can be easily transported to Vale’s underground mines, and can be simply operated and maintained.

#### Ventilation-On-Demand (VOD) Demonstration Project: Model Development Module - Project Leader, CEMI, Sudbury, Canada, Mar. 2011.

Worked with project partners from Vale and Xstrata to develop the *business case model* of the VOD Demonstration Project. The business case model was used to quantify the economic and environmental benefits of two VOD systems, one installed at Coleman/McCreedy East Mine (Vale), and the other one installed at the Nickel Rim South Mine (Xstrata). The business case model was also used to determine the economic and environmental benefits of various levels of VOD control such as: time-of-day, event-based, dynamic control at other underground mines in Canada. Performed long-term field studies and detailed laboratory assessments to measure the performance, reliability, and robustness of the VFD-equipped primary fans, louver-type regulators, vehicle tracking systems, gas sensors (CO, CO2, NO, NO2). Performed in-situ diesel particulate matter monitoring and mapping to assess the possibility to transition from an *air quantity-based* VOD control system towards an *air quality-based* VOD control system.

#### Ventilation Survey at the Nickel Rim South Mine Using Tracer Gas - Project Leader, Xstrata Nickel, Sudbury, Canada, Jan. 2011.

Conducted a barometry and tracer gas-based (SF6) ventilation survey to determine the air volumes along the Production Shaft and the Ventilation Shaft. Performed climatic and barometric pressure measurements to determine the pressure losses and the friction factor (K) along the main shaft, ventilation shaft, main production airways and haulage drifts. Through tracer gas-based measurements, the amount of controlled fresh air upcasting the upper section of the Main Shaft (intake plenum - surface) as well as the magnitude of leakage from the surface through the capped collar of the Ventilation Shaft into the exhaust ducts was also quantified. These parameters were used to determine the operating duty of the primary fans. Provided recommendations to improve the efficiency of the mine’s primary ventilation system.

* 1. **Ph.D. Dissertation: *New Ventilation Design Criteria for Underground Metal Mines Based Upon Life-Cycle Airflow Demand Schedule*, Department of Mining Engineering, University of British Columbia (UBC), Vancouver, Canada, Jul. 2009.**

Developed a new ventilation design method by integrating discrete-event mining process simulation (DES) and ventilation simulation techniques. Based on the output data generated by discrete-event mining process simulations performed on a dynamic mine model, the *life-cycle* airflow demand schedule of a mine was determined for “traditional” versus “activity-based” ventilation requirements. The output data generated through ventilation simulations were also used to quantify the economic and environmental benefits of a potential ventilation-on-demand (VOD) control system versus traditional ventilation practice.

#### Analysis of the climatic conditions, and their cause that could be expected in deep mechanized metal mines, *Deep Mining Research Consortium*, Sudbury, Canada, Sep. 2008.

This study predicts and highlights the working conditions that could be experienced in a 3,000m deep highly mechanized metal mine in Canada. This investigation used a combination of climatic monitoring and modeling to predict the climatic conditions (Td, Tw, and RH) along the intake and exhaust airways and within the production areas. Analysis of output data generated through climatic modeling focused on changes in dry and wet bulb temperatures (Td, Tw) and the change in the “Sigma Heat” content of the mine air. Climatic simulations were performed to quantify the individual contribution of the main heat sources (i.e. auto-compression, strata, equipment, main fans) on the climatic conditions in the production stopes.

#### Ventilation System Optimization at Niobec Mine, IAMGOLD, St. Honore, Quebec, Canada, Mar. 2008.

Based on a combination of tracer-gas, anemometry, and pressure survey developed the ventilation model of the Niobec Mine operated by IAMGOLD. The ventilation model was used to evaluate current and future ventilation requirements and fresh air delivery options as the mine was planned to deepen from the 1450 level to the 2350 level. This work established current and future ventilation requirements, determined the controlling ventilation elements of the system and identified major restrictive intake and exhaust airways with high frictional and shock pressure losses. Ventilation simulations identified various options to improve the efficiency of the mine’s current system, reduce fan power and energy consumption.

#### Ventilation Survey to Quantify Leakage from an Exhaust Duct into the #1 Intake Shaft at Coleman/McCreedy East Mine, Vale - Project Leader, Levack, Ontario, Canada, Jul. 2007.

The objective of this project was to determine the leakage from a 72” exhaust duct (installed inside the #1 Intake Shaft) into the fresh airstream. With both booster sets and the surface fans operating, tracer gas (SF6) was released into the exhaust duct, in front of the booster fans located on the 3830 level. Air samples were concurrently collected from the exhaust ducting system on the 3830 level, from the bottom of the #1 Intake Shaft (3830 level), and on the surface in front of the exhaust fans. Based on the release rates of the tracer gas (SF6) and the concentrations in the collected samples (ppb), the air volume delivered through the 72” exhaust duct, and the leakage from the 72” exhaust duct into the #1 Intake Shaft was quantified. Provided recommendations to improve the efficiency of the mine’s primary and auxiliary ventilation systems.

#### Identifying Opportunities to Reduce Energy Consumption at Various Metal Mines within the Province of Quebec - Hydro Quebec, Montreal, Canada, Jan. 2007.

Based on the information provided by Goldex, Lapa, LaRonde, Doyon, Mouska, Niobec, Kiena and Raglan mines, analyzed and classified all underground base and precious metal mines within the province of Quebec to identify which operations would benefit the most from the introduction of various levels of ventilation automation and control systems (e.g. ventilation-on-demand). Performed a detailed underground fan power and energy consumption audit at the Niobec Mine operated by IAMGOLD. Performed a detailed ventilation cost benefit analyses for the above mentioned underground mines.

#### Ventilation Optimization at Kidd Creek Mine, Pre-Feasibility Study, Falconbridge Limited, Timmins, Ontario, Canada, May 2006.

In collaboration with AMEC, Genivar and Falconbridge Limited (now Glencore), worked on a feasibility study, which focused on optimizing the mine’s current and future ventilation system. The main objective of this study was to evaluate several ventilation control options such as: *time-of-day*, *event-based* and *dynamic control* to reduce the mine’s intake air volume. This study showed that the overall reduction in energy consumption is a function of the available “intelligence” within the mine’s primary and auxiliary systems (e.g. variable frequency drive equipment fans & PLC based control).

#### Engineering Study to Reverse Fresh Air Delivery below the 720m Level at the Hoyle Pond Mine, Goldcorp Limited - Project Manager, South Porcupine, Canada, May 2006.

Modified Hoyle Pond mine’s ventilation model to reverse the mine’s intake fresh air along the main ramp below the 720m level. Through ventilation modeling, determined the effects of airflow reversal along the main ramp (below 720m level) on the operating duties of the mine’s primary fans (surface & boosters). Assessed and reviewed the practicability of such modifications in view of health and safety considerations in case of a potential mine fire that would ignite below the 720m level.

#### Heat Study and Climatic Modelling at Coleman Mine’s 170 Orebody, Inco Limited - Project Manager, Sudbury, Ontario, Canada, Dec. 2005.

This research project was undertaken to evaluate the heat sources and estimate the climatic conditions that will prevail within the future 170 Orebody at Coleman/McCreedy East mine. Determined the mine’s total heat load and the rate of heat energy transferred to the ventilating air from various heat sources such as: strata, auto-compression, mining equipment, and fans. Through climatic modeling, predicted the climatic conditions within a typical development heading, production workings, and along the main access ramp of the future 170 Orebody. Provided solutions and recommendations to minimize potential heat problems throughout the deep levels of the mine’s active 153 Orebody.

#### Engineering Study for Surface Fan Upgrade and Expansion at Hoyle Pond Mine, Placer Dome –

**Project Manager, South Porcupine, Ontario, Canada, Jul. 2005.**

Conducted an underground tracer gas and barometry-based ventilation survey to establish the resistance and friction (K) factors of the mine’s primary airways. Based on collected data and mine layouts, developed and calibrated the ventilation model of the mine. Through ventilation simulation techniques sized the mine’s primary fans, and provided airflow delivery options from the year 2005 to year 2012, as deeper levels are being planned to open. Provided solutions to optimize the mine’s primary ventilation system.

#### Mine Ventilation Modelling at Kidd Creek Mine, Falconbridge Limited - Project Manager, Timmins, Ontario, Canada, Feb. 2004.

Based on the information provided by the mine’s engineering department, developed Kidd Creek mine’s ventilation model, which included Mine #1, Mine #2, Mine #3, and the deep mine (Mine D) from surface to Level 88, using a mine ventilation software package. Solved and balanced the ventilation system to determine the airflow distribution within the mine’s primary airways, pressure losses, and the operating

duty of the primary fans (surface/boosters). Predicted the climatic conditions (Td, Tw, and RH) throughout the deep mine (Mine D) by means of climatic modeling.

#### Fuel Cell Loader Project - Mine Ventilation Cost Benefit Analysis, Vehicle Projects LLC - Project Leader, Denver, Colorado, USA, Jul. 2003.

Evaluated mine ventilation implications and performed a detailed cost benefit analysis for typical base and precious metal mines across Canada, to determine potential ventilation savings assuming that underground production diesel LHDs would be replaced by fuel-cell powered LHDs. Performed an environmental impact assessment to determine the Canadian mining industry’s overall reductions in greenhouse gas emissions in CO2 equivalent (tonnes/year), as a result replacing U/G production diesels with fuel-cell powered LHDs.

#### Feasibility Study - Ventilation Automation at Creighton Mine, Inco Ltd., Sudbury, Canada, May 2002.

Updated Creighton mine’s ventilation system to include current and future developments within the Deep Orebody using a mine ventilation software package. For the remaining life of the mine, four different airflow delivery scenarios were analyzed and the ventilation requirements were determined by means of simulation techniques. Determined capital and operating costs, and quantified the environmental benefits for Creighton mine’s future automated ventilation system vs. traditional ventilation practice.

#### Heat Study: Hybrid vs. Diesel LHDs, CANMET-MMSL – Project Leader, Val d’Or, Canada, Feb. 2002.

Through underground climatic modelling, conducted a comparative heat generation analysis between production diesel LHDs and hybrid (electrical-diesel) LHDs. Determined possible fan power and ventilation operating cost reductions, as well as potential environmental benefits (e.g. reductions in DPM) as a result of replacing conventional diesel LHDs with diesel-electrical hybrid LHDs in narrow vein mines.

#### Ductless Auxiliary Ventilation Systems Using Jet Fan: The Mining Automation Program- Project Leader, Inco Limited, Sudbury, Canada, Oct. 2001.

As part of Inco’s Mining Automation Program (MAP), conducted performance tests of an auxiliary ventilation system equipped with a 48” free standing jet-fan by means of tracer gas (SF6) based ventilation surveys. Results of this research work were used to evaluate the possibility of designing and constructing a maintenance free ductless auxiliary ventilation system for mines where development & production operations are fully automated or remotely controlled from a surface.

#### Ventilation Audit at Sifto Mine, Goderich, Ontario, Canada, Jul. 2001.

Performed a tracer gas (SF6) & barometry ventilation survey at the Sifto Mine, to evaluate the performance of the mine’s primary ventilation system as a result of replacing two Joy Axivane M72-43 fans, with two new Joy Axivane M96-58 fans. The airflow distribution throughout the mine was predominantly determined through the tracer gas dilution method and ventilation simulation techniques.

#### Remote Mining Operations – The Mining Automation Program (MAP), Inco Limited, Sudbury, Canada, Sep. 2000.

Conducted an environmental assessment and determined the operating characteristics of all remotely controlled equipment such as the Data-MiniTM & Data-SoloTM drills, and various capacity LHDs operated remotely from the surface. Redesigned the mine’s auxiliary ventilation system to match the new air volume requirements for this advanced extraction method.

#### TeleminingTM Processes - Mining Automation Program, Inco Limited, Sudbury, Canada, Jul. 2000.

Collected and analyzed equipment performance data during the TeleminingTM processes (production and development). Provided recommendations to eliminate equipment failure-related delays.

#### Development of 3D-CanventTM Mine Ventilation Software, CANMET-MMSL, Sudbury, Oct. 1999.

Involved in the development 3D-CanventTM mine ventilation software package for modeling, design, and analysis of underground mine ventilation systems.

#### Auxiliary Ventilation Design for Tunneling, Golder Associates, Belo Horizonte, Brazil, Jun. 1999.

Designed the infrastructure of an auxiliary ventilation system to deliver fresh air to the advancing face of a 1.5-km tunnel. Two airflow delivery scenarios were developed and analyzed. Performed a detailed cost-benefit analysis for Scenario 1 vs. Scenario 2.

#### Hydrogeology Study for Onaping Depth, Falconbridge Limited, Sudbury, Canada, Apr. 1999.

Analyzed diamond drill cores and classified the rock mass to determine the permeability properties of the intercepted rock formations. These properties were then used in a hydrogeology study. The main objective of the hydrogeology study was to identify the optimum location of a new extraction shaft.

#### Development of the Blast Central Software Package, Explosives Technologies International Inc., Sudbury, Canada, Jul. 1998.

Involved in the development of the Blast-CentralTM software package for analysis, design, and reporting of underground and quarrying blasting procedures (using Visual BasicTM, HTML WorkshopTM software).

#### Geotechnical Modelling at McClean Lake, Cogema Resources, Saskatoon, Canada, Dec. 1998.

Involved in geotechnical modeling and engineering work for a pre-feasibility level study on two separate uranium deposits, Midwest and McClean Lake, Saskatchewan, Canada.

#### Ore and Waste Handling System at Coleman Mine, Vale Inco, Levack, Canada, Apr. 1997.

Involved in the development of a computer simulation model of Coleman mine using a process simulator (e.g., AutoModTM) with the aim to improve the efficiency of the mine’s underground haulage and hoisting systems by means of discrete-event process simulation techniques.

#### Open Pit and Plant Design at Poiana Aidului Mine, Poiana Aiudului, Romania, May 1995.

Coordinated the activity of a mining engineering team in open-pit design, including short and long term production scheduling and equipment selection.

#### Feasibility Study: New Iron Deposit, Baisora Mine, Cluj-Napoca, Romania, Jun. 1993.

Involved in mineral reserve estimation work. Performed an economic analysis based on future market demands.

# Honors and Awards for Teaching and Research

1. *SME Health & Safety Research, and Educational Excellence Award for 2019*: The award recognizes outstanding dedication and leadership in exploration, mining, extractive metallurgy, and occupational safety and health management. The following citation has been prepared for the award: “*For his efforts to educate and train students and junior faculty in mine ventilation and the research and implementation of innovative technological and analytical solutions*”. Award was presented at the SME Conference in Phoenix, Arizona, February 23-26, 2020.
2. *Mackay School of Erath Sciences and Engineering Distinguished Faculty Award for 2018*: The award was presented at the Mackay Banquet by Dr. Jeffrey Thompson, Dean, College of Science, University of Nevada-Reno, May 4, 2018.
3. *Westfall Scholar Mentor Award, spring 2018*: The award was presented by Dr. Jeffrey Thompson, Dean of the College of Science, University of Nevada-Reno, April 15, 2018.
4. *2016 SME Academic Career Development Award*: The SME career development grant was provided by Freeport McMoRan to support Dr. Kocsis’ research, publication, and professional service. The award was presented by the Chair of the SME Grant Evaluation Committee, Feb. 17, 2017.
5. *Westfall Scholar Mentor Award, fall 2016*: Award was presented by Dr. Jeffrey Thompson, Dean, College of Science, University of Nevada-Reno. Nov. 2016.
6. *SIMPRO 2016 Honorary Award*: Award was presented to Dr. Kocsis by the SIMPRO Chairman at the 7th Edition of the International Symposium on *Sustainable Development through Quality and Innovation in Engineering and Research*. University of Petrosani, Romania, Oct. 14-15, 2016.
7. *Natural Resources Canada Excellence Award*: Award was provided to Dr. Kocsis in recognition of exceptional achievements in research and development, and his dedication to improve safety and health at surface and underground mines while with CANMET-MMSL, Minerals and Metals Sector of Natural Resources Canada. The award was presented by the Assistant Deputy Minister of Natural Resources Canada, Ottawa, Canada, February, 2012.
8. *CANMET-MMSL Flagship Project Award*: Certificate of appreciation for outstanding performance and on-time delivery of CANMET-MMSL flagship project: “*Development and Installation of Ventilation-On- Demand (VOD) Systems in Underground Mines*”. Award was presented by the Director General of CANMET-MMSL, May, 2011.
9. *Natural Resources Canada Award*: Award was provided to Dr. Kocsis in recognition of his outstanding contribution in supporting and organizing the 9th North American Mine Ventilation Symposium held in Kingston, Ontario, Canada, June 8-12, 2002. Award was presented by the Assistant Deputy Minister of Natural Resources Canada.