



C E M I
Centre for Excellence
in Mining Innovation



Annual Report 2010

Overview



The Centre for Excellence in Mining Innovation (CEMI), located in Sudbury, Ontario, is expanding its R&D efforts to facilitate the delivery of step-change research initiatives of critically importance to the mining industry. It strives to establish excellence in strategic areas of research: deep mining, mineral exploration, integrated mine engineering, and sustainability of mining.

Vision

Become a **world-class, networked** centre to carry out **industry-focused** research and innovation, advance concepts, processes, and methodologies in support of regional, national, and international

- exploration and mining industries
- suppliers and service providers

Mission

- **Add value** to mining operations in Ontario and beyond
- **Strengthen capacity and develop highly qualified personnel (HQP)** to undertake world class collaborative research
- Form a hub of **networked mining innovation expertise**
- **Foster growth** of mining excellence in Canada

CEMI Program Team

Peter Kaiser
President and CEO

Allan Akerman
R&D Program Director
Operations Manager

Glenn Lyle
R&D Program Director

Damien Duff
R&D Program Director

Keith Bullock
R&D Program Director

Natalie Lafleur-Roy
Finance & Operations

Jane Djivré
Business Development

Shannon Katary
Marketing & Human Resources

Benoît Valley
Scientific Advisor

Andrew Wilson
Research Engineer in Training

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... *from the Chairman*



CEMI has gone far in achieving its role as an agent of change through innovative, step-change solutions, by linking industry to a network of experts, and by funding and managing collaborative projects. CEMI has and continues to actively engage industrial partners through project participation.

Three new board members were elected to the Board this year: Mr. Warren Holmes, Chairman Nuinsco Resources; Ms. Suzanne Herbert, former Deputy Minister, Ministry of Northern Development and Mines for Ontario; and Dr. Nigel Smith, Director of the SNOLAB. With their input, the Board has expanded its reach and been able to successfully develop a growth and sustainability plan for CEMI.

We also welcome Anil Arora, the Assistant Deputy Minister, Natural Resources Canada, Minerals and Metals Sector and we thank Stephen Lucas for his efforts in the development of excellence in mining innovation.

With the addition of Keith Bullock, seconded from Xstrata Nickel to serve as the fourth R&D Program Director, CEMI has expanded its strong team of industry experts. Collectively, the staff brings over 150 years of industrial and academic research experience together to identify innovative research teams and lead the scoping and implementation of projects within each theme.

Significant progress has been made by CEMI in advancing mineral exploration and mining-related research during the past year. The Ventilation on Demand project is well underway thanks to the support of the Community Adjustment Fund (CAF) from Industry Canada which made a crucial \$4.25 million grant available in August 2009. This project focusses on one of industries most critical issues - Energy reduction for deep mining. It also demonstrates that R&D can be accelerated by strategic investment buy-in.

On behalf of the board, I would like to thank the team at CEMI for its vision and leadership as well as for its endless efforts to make CEMI and its collaborators successful.

A stylized, handwritten signature in black ink, consisting of several loops and a long horizontal stroke.

Marc Boissonneault
Chairman of the Board

Board of Directors



Michael MacFarlane
Vale



Marc Boissonneault
Xstrata Nickel



Christine Kaszycki
Ontario (MNDMF)



Fred Delabbio
Rio Tinto



Dominic Giroux
Laurentian University



Suzanne Herbert
MNDMF (Former DM)



Warren Holmes
Nuinsco Resources



Nigel Smith
SNOLab



Anil Arora
NRCan
(External Observer)



Peter Kaiser
CEMI

Research Management Committee



Patrice Sawyer
Laurentian University



Doug Morrison
Golder Associates



Catharine Farrow
QuadraFNX Mining



Roger Emdin
Xstrata Nickel



Mark Board
HC Itasca Denver



Alex Henderson
Vale



Dougal McCreath
Laurentian University



Doug Goldsack
University Liaison

... *from the President*



This year, CEMI is focusing on its role as a networked institute of advanced studies dedicated to facilitate and accelerate mining innovation with customized teams of innovators who link industry with excellence in academia, government and the private sector. We have expanded both our corporate and innovator membership to tackle value-adding projects and support step-function developments. In this manner, we are supporting R&D to lower risks, create value, and raise the level of excellence in mining innovation in Canada.

Our program development team, with extensive industrial experience, gives CEMI a key advantage in that we are able to tackle major initiatives and deliver quality results in a timely fashion.

The three major initiatives that were and continue to be pursued this year focus on energy savings through use of Ventilation on Demand; rapid mine excavation through innovative underground mine construction, with focus on associated ground control requirements; and risk identification and management for mining in complex deep ore-bodies.

Funding to deliver major projects on time and budget

This was demonstrated this year by a large-scale project on Ventilation on Demand (VOD) funded by the Community Adjustment Fund (CAF). In less than 18 months and in difficult times with labour disputes, we worked with our stakeholders to demonstrate the value of ventilation on demand at two of our founding members' sites.

This program also demonstrated one of CEMI's strategic values for Northern Ontario. In collaboration with NRCAN/CANMET, Vale and Xstrata Nickel, over three million dollars of research and development was undertaken by northern businesses, creating new jobs and a start-up company as well as strengthening the capability of existing businesses. This project is not only contributing to the Provinces' need to reduce energy consumption and to increase the competitiveness of the mines, but also stimulates economic development.

Strengthening solution teams and collaboration with Universities

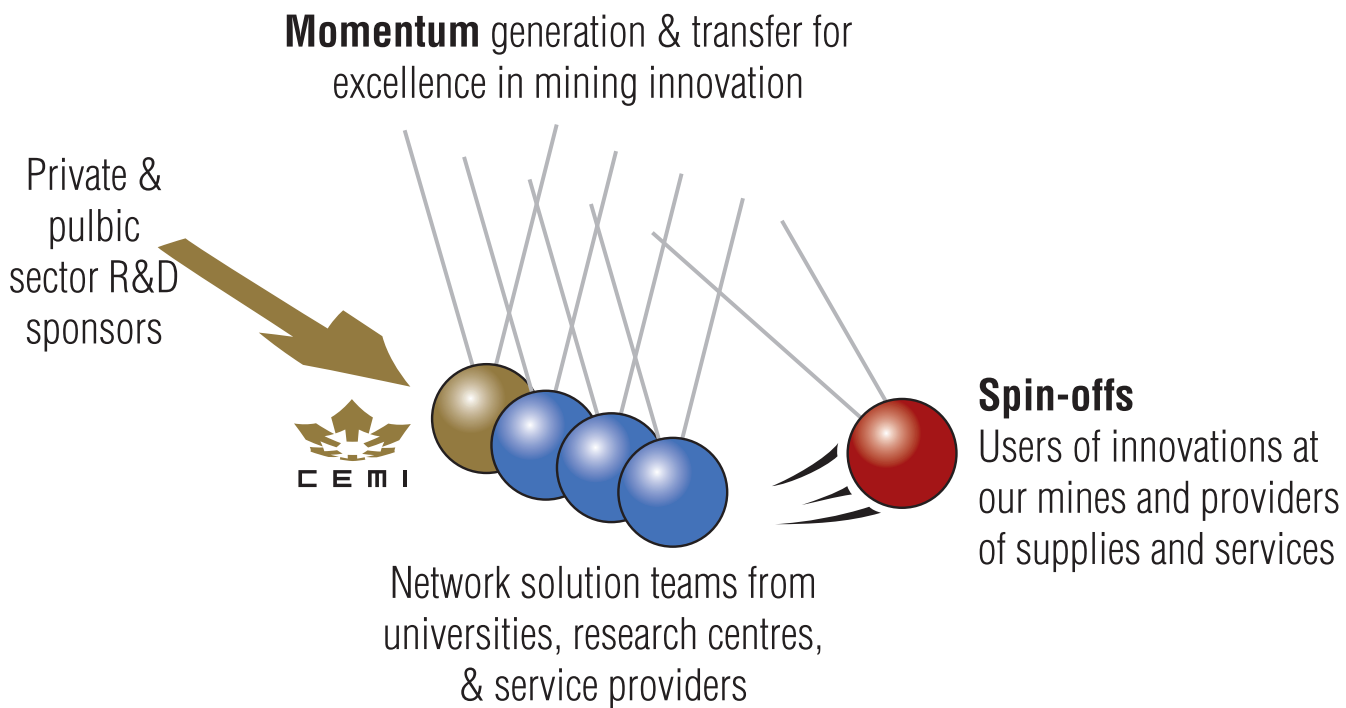
By expanding the strategic GeoRisk project to focus on fault slip control, a new initiative called IFSCRI (International Fault Slip Control Research Initiative) was started with the goal of establishing a series of related experiments in our living laboratories, i.e., Canadian Mines. Over 100 individuals from around the world have contributed to the development of a R&D plan that will be put into action this coming year. Details are available from our website. In collaboration with researchers from Laurentian and Queens universities, and the University of Toronto, the Lassonde Institute, we will approach the Ontario Research Fund for funding of a new initiative on integrated monitoring and control systems for deep mining.

Increasingly acting as a change agent of the mining industry, CEMI is focusing its strategic research program and engaged in step-function developments such as the railveyor and mechanized excavation. In collaboration with Rio Tinto, we are expanding our solution teams for research related to the implementation of mechanized tunnelling and shaft sinking technologies. Rio Tinto has contributed one million dollars to addressing ground control issues related to mechanized excavation at depth. With eventual test sites on

possibly three continents, it will be of strategic importance to strengthen collaborations with expertise beyond our boundaries.

Gaining momentum

The momentum transfer experiment illustrated below reflects how CEMI is gaining momentum and transferring benefits in many ways. CEMI is attracting new sponsors, supporting solution team members and innovators, and delivering results to our stakeholders with spin-off benefits to private sector businesses. This year's R&D budget was doubled, our solution team was expanded, valuable solutions were produced (see 2010 Innovator Showcase), and the foundation for growth was established.



Performance goals:

This year's budget has been structured to achieve four performance goals

- **Deliver value** through CEMI's Strategic Research Programs. Knowledge and technology transfer and solution team expansion, including support of lead researchers to develop capacity for excellence in mining research.
- Successfully **complete VOD project**. Demonstrate business case and create ability to control quality and attract funding to expand energy related innovation.

- Develop and start **implementation of a growth model** based on concept of establishing international test sites for deep mining.
Starting with IFSCRI as the “prototype” and expand by aligning with national R&D initiatives (Energy, Green Mine, etc.).
- Build foundation for **long-term funding** for CEMI-led programs.
Implement succession plan and accelerate membership drive while building government support for mining research and innovation.

A vision for the future

Our vision for the future evolves around the establishment of a virtual Deep Mining Observatory with SNO as a role model. This observatory will link academia with international test sites that facilitate the development of step change technologies and processes through experimentation, monitoring and control system development in our living laboratories – the mines.

While not constraining ourselves to a narrow pallet of flavours, CEMI will initially focus on strategic issues emerging from current focal points in CEMI's DeepMine program:

- GeoRisk – investor risk reduction when mining in deep, complex ore bodies, e.g., fault slip control, ground control ...
- SustainMine – mine environment and energy reduction in deep mines, e.g., ventilation, insulation ...
- ConstructMine – rapid excavation and support for mine development, e.g., machine and ground performance, cycle optimization ...



Peter K. Kaiser
President & CEO

Support by the Numbers

Committed to
Strategic R&D Programs

\$4M

Committed to
over 20 research projects

\$2M

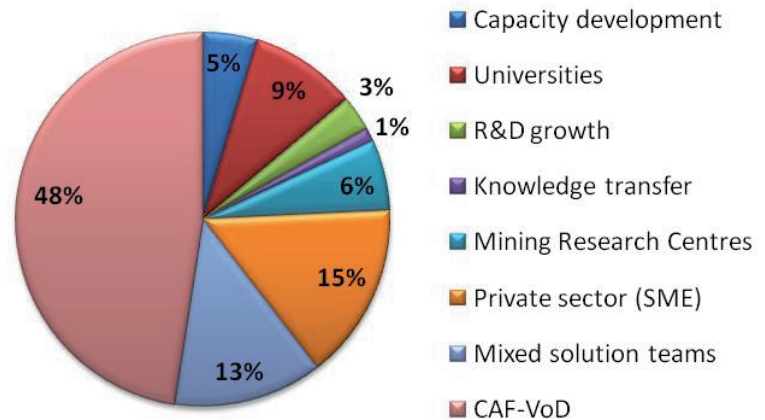
Committed to
Research Chairs

\$2M

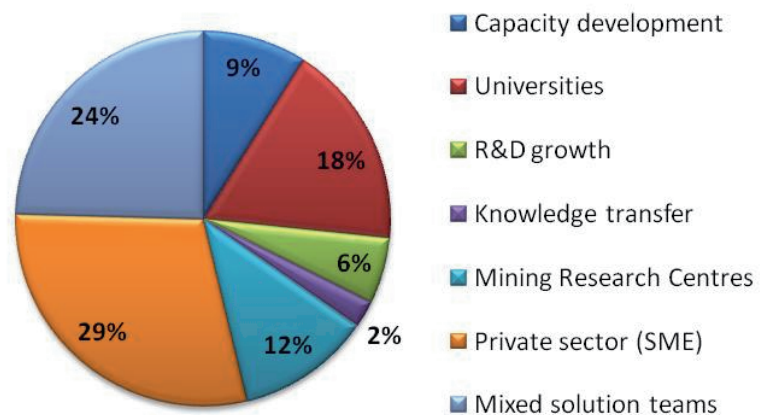
Committed to
SME-led projects

\$1M

2009-2010 Total R&D fund allocation: 5.8 M\$



2009-2010 Fund allocation without CAF



CEMI Advantage



GeoRISK

Within the overall focus on deep mining (DeepMine), six strategic research programs (SRPs) are well supported by our stakeholders and highlighted in this report:

GeoRisk, ConstructMine, ValueMine, FindMine, SustainMine, and MineTech

Progress in these programs is facilitated by the R&D efforts of our collaborators as highlighted throughout this report.



ConstructMINE

Objectives

The objectives of the SRPs are to meet the needs of the industry-directed strategic R&D projects and create a strategic, long-term niche for CEMI as the recognized centre of mining excellence internationally. The SRPs are managed by the Program Directors with at least one private sector strategic advisor and networked solution team developers. Members can choose which SRPs they wish to join and what part of the program they would like to support (see membership). As important side products, the SRPs are providing an opportunity to attract and train high quality personnel (HQP) and specific “products” of commercial or social value.



ValueMINE

In an effort to deliver knowledge transfer in a timely fashion, all SRPs aim to deliver guidelines, manuals or publication for mine staff, educators, and consultants. The development of a Wiki-based “Mine Design Best Practice Handbook” that will go online shortly. This will serve as an up-to-date reference helping to bring together the expertise and experience of the top minds in the industry.



FindMINE

Sharing results

One of CEMI’s advantages is in sharing results of collaborative R&D initiatives with our collaborators in industry, academia, and government.

- A virtual library is under development, as an online database, to bring relevant reports and publications to our members. This library will contain reports from previous research and from outside SRPs.
- The Lecture Series and Short Courses program are designed to transfer knowledge of our networked solution teams to future engineers and researchers.
- Software package developments with Mira GeoScience and RocScience are available for beta-testing by members and will eventually become available as part of their product line.



SustainMINE

A critical advantage comes from our ability to leverage sponsor funds as demonstrated this year by the successful attraction of stimulus funds from the Federal Government’s Community Adjustment Fund (CAF).



MineTECH

Industry Experience

R&D Program Directors



Damien Duff

Damien has worked in the mineral industry for 30 years, the last 21 years with Xstrata. In 2006, he was seconded to the Ontario Ministry of Northern Development and Mines, Mines and Minerals Division, as a Senior Advisor to the Assistant Deputy Minister. More recently, he has spent 3 years on secondment to CEMI as an R&D Program Director.

Project Lead

GeoRisk Mitigation for Mining Highly Stressed Ore Bodies at Depth
International Fault Slip Control Research Initiative
Environmental Studies & Mine Sustainability
Mineral Exploration and Geophysics



Allan Akerman

Before joining the CEMI team in 2008, Allan worked at Vale for 32 years. One of his roles included being the Superintendent of Central Maintenance, Ontario Division of Vale, with responsibility for Combustion Services, NDE, Maintenance Specialists (Materials, Hoists, Technology, Quality Control), Maintenance Training and Apprenticeships, EIT Program, and Maintenance Systems Support.

Project Lead

SME-led Initiatives
University-led projects
Fragmentation



Keith Bullock

Prior to joining CEMI on secondment in 2009, Keith worked 22 years at Xstrata Nickel covering a diverse number of roles. Most recently he was a Mine Manager at Montcalm Mine in Timmins. His background in engineering and operations is a good fit with the strategic direction of CEMI.

Project Lead

Ventilation On Demand
Underground Construction
Risk Management



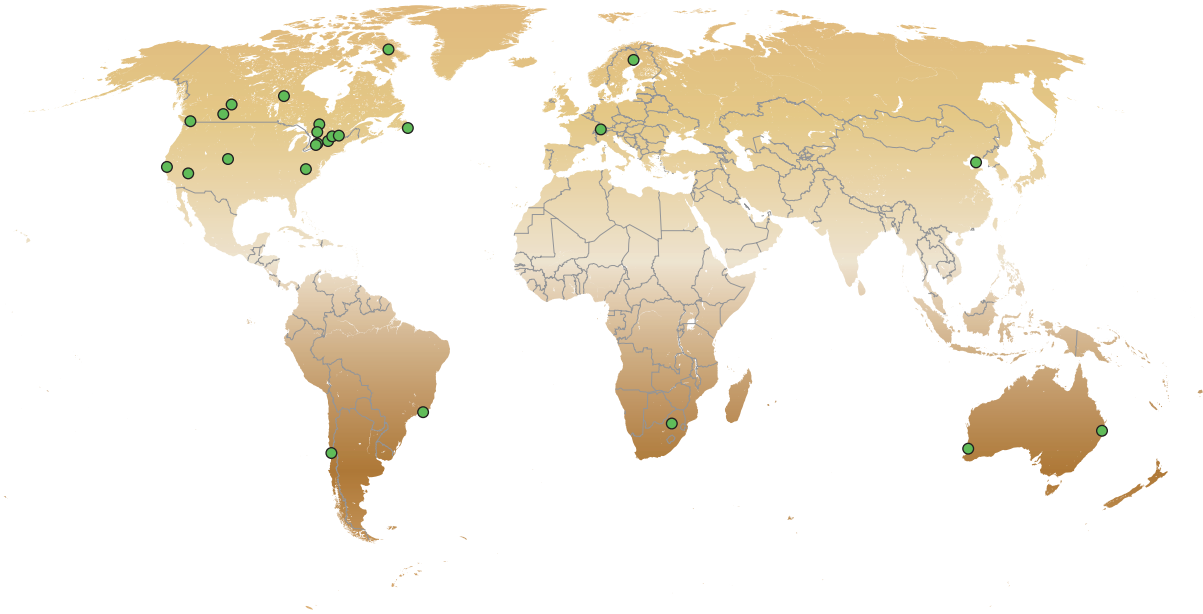
Glenn Lyle

Prior to joining CEMI, Glenn worked for 33 years at Vale in a number of roles - most recently as Project Manager in the Mines Projects Development Group from Nov. 08 to March 09. He co-ordinated and provided direction on the work of several project leads, each capital project in the range of \$5-\$20 million.

Project Lead

Mine Design Wiki Handbook
Ventilation On Demand

Forging Network...



Over the past year, many small and medium enterprises (SMEs) have been actively engaged in research projects and the commercialization of research findings through enabling technologies and related services. CEMI supported the research required by Symbolicware to produce and apply new products such as the SymBot. In collaboration with Laurentian University and Baffinland Iron Mines Corporation, the SymBot is being tested for water and weather data collection.

Some of the brightest minds, from universities (Queens University, Laurentian University, the Lassonde Institute, Laval University, C-Core at Memorial University of Newfoundland, UBC, McGill, and others), to consulting companies (Itasca Canada Inc., Golder Associates, Stratos Inc., LCG Energy Management Group, SRK Consulting, Xstrata Process Support (XPS), Mira Geoscience, and others) to research centres (MERC, MIRARCO, and others) have been engaged in successful projects and networking opportunities. For example, Dr. Chunan Tang from the Centre for Rock Instability and Seismicity Research, Dalian University of Technology, China, was the first visiting scholar in CEMI's Visiting Scholar Program. He is a long-term collaborator who will facilitate collaborative projects in rockburst prone ground and a representative of the Engineering Seismology Group (ESG of Kingston, Ontario). In addition to working closely with CEMI and partners, Dr. Tang held a well attended short course on the numerical code model, Realistic Failure Process Analysis (RFPA).

This network has been widened through CEMI's active participation as a founding member of CMIC (Canadian Mining Innovation Council), collaborations with CANMET, CAMIRO (Mining and Exploration), NORCAT and SAMSSA, and by the work of collaborative steering committees with international participation (currently Austria, Australia, Chile, South Africa, Sweden, Switzerland, UK, USA).

Solution Teams

Board and Corporate Members



Project Sponsors



Collaborators



Network Partners





SustainMINE

Ventilation on Demand

Sustain mining with less energy requirements

Project Leads

Glenn Lyle and Keith Bullock

Purpose

The Ventilation on Demand (VOD) project will install, test and measure the efficiency of novel Ventilation on Demand technologies to decrease energy costs and increase productivity. This project will assist to increase productivity, decrease the environmental impact of energy consumption, and create jobs.

Adding value to a major industrial initiative

Both industry and government felt that it was essential to accelerate this work to derive benefits for the industrial and private sector. Realizing the potential benefits of ventilation on demand from a health and energy-consumption reduction perspective, industry in collaboration with various supply and services providers has focussed its efforts on new control technologies. With the Community Adjustment Fund, two demonstration sites have been accelerated to establish the benefits of VOD and to provide baseline data for future developments. With its short timeline (18 months), the program directors have worked closely with industry and supply and services companies to deliver value to sponsors. Key contributors and collaborators, Vale, Xstrata Nickel, NRCAN/CANMET, Bestech, and Objectivity, have been working together to advance this project in a timely fashion.

When CEMI was established as a corporation in 2007 for excellence in mining innovation, this type of project was at the core of what industry saw as the role of the organization, contributing to industry's need, closing research gaps, and working with expert solution teams. With the VOD project ending in March 2011, we are completing a first milestone project addressing one of core issues of industry.

Adding value by attracting funding

Based on input from industry and project collaborators, a clear set of objectives was established and vetted by the project team prior to submission. The team was able to rapidly establish the project goals, secure funds and involve SMEs and researchers, partly because industry had already initiated work on this critical subject, which is a strong testament to the capability of CEMI to work with and for its partners. Additional projects of a similar nature are under development as described throughout this Annual Report.

A combined total of \$4.25M was contributed by Vale and Xstrata Nickel, which was matched through the CAF program, for a combined project total of \$8.5M.

Adding value as a networked institute of advanced studies

The VOD project was initiated immediately following industry's agreement, with funding sought and received from the Federal Government (CAF) to augment contributions provided by industry. Key to the ability to secure government funding was a close collaboration with NRCAN/CANMET and representatives from CMIC (the Canadian Mining Innovation Council). This ability to work closely with a national agency gave the Government appreciation of the project depth and commitment from multiple partners,

securing the funding required to complete a project of this magnitude. The funding secured the resources and partners necessary to scope and deliver a comprehensive project.

The founding industrial sponsors also committed themselves to providing technical resources to ensure the delivery of quality on time. A steering team and a technical team comprising personnel from among the noted collaborators were formed and play a key role in the project's direction and success to date. Innovators such as BESTECH, Symboticware and Objectivity have helped drive the project forward by amalgamating developments in their areas of expertise to resolve larger problems difficult to address on their own.

Demonstration of value at Canadian in mines and beyond

The project focusses on two mine sites: Vale's Coleman and Xstrata Nickel's Nickel Rim South Mine. The technical solution at Coleman is provided by BESTECH and at Nickel Rim South Mine by Simsmart.

The project has supported SMEs by delivering more than \$3M dollars to the Sudbury community. One of the results has been the creation of a new SME which is expanding its business inside and outside the mining industry – a most positive and sustainable outcome of the VOD project.

Project snapshot

The primary goals of the project are:

1. Develop a proof of business case for VOD.
 - a. When should VOD be considered? Is it valid in all cases? Is it best suited for newly developed mines or can it be used in existing operations?
2. Quality versus Quantity.
 - a. How to define the practices, systems and equipment required to support a quality based ventilation system, as well as to determine whether a quality approach is practical?
3. Sensor assessment.
 - a. Can existing sensor technology meet the requirements of the project?
 - b. Where is the best location for sensor placement to ensure reliable data for controls?

Team Members



Completed

Installed underground sensors.

Currently collecting data from Nickel Rim South and Coleman Mine.

Underground demonstration projects have been established.

Software has been developed, allowing the project to link differing mining scenarios with ventilation requirements.



CEMI, Vale, and Xstrata Nickel are members of the NRG1-ECO - Energy Consumption Optimization Consortium led by BESTECH, to prove the feasibility of Ventilation on Demand - Mines Emission Reduction Initiative (MERI) project has Federal funding through Sustainable Technology Development Corporation (STDC).



ConstructMINE

Underground Mine Construction

Project Leads

Peter K. Kaiser and Keith Bullock

Purpose

This program supports projects for underground construction utilizing both conventional drill and blast as well as mechanical excavation and focuses on five key aspects:

- Speed and quality of underground infrastructure construction including shaft sinking and tunnelling logistics;
- Development and design of innovative support methods for different excavation systems including prototype development and testing;
- Reliable prediction of rock behaviour to properly select and implement construction technologies including effective, advanced ground characterization procedures;
- Improvements of machine performance from an equipment and ground management perspective; and
- Use of smart (observational) approaches when working with the rockmass to minimize risks and uncertainties, including feedback processes to facilitate flexibility in matching construction to conditions encountered in complex ore bodies.

In this manner, CEMI will establish excellence in underground mine development for new and operating mines, focus on ground control issues to facilitate the implementation of new and mechanized technologies, and develop innovative ground control means for mining at depth.

Value proposition

Time is money! Increasing development rates can add hundreds of millions to NPV.

The transition from open pit to underground mines forms a world-wide challenge. For one mining company alone, this requires on average 5 shafts and over 50km of tunnels per year. While technological advances facilitate higher drilling speeds, overall advance rates are dropping.

Project status

For pre-operational development - new mines - mechanized excavation technologies are under development by Rio Tinto for both shaft and tunnel advance with target speeds of >10m/day. Ground control plays a key role in ensuring successful application of these step-function technologies. CEMI was invited to assist in the development of innovative support systems and in minimizing the risks for such technologies.

Rio Tinto has provided start-up funding during the technology development phase. Now that the first tunnel boring system is ready for construction, the project moves into the field testing phase with one or two horizontal development tests being planned for 2011 and 2012.

CEMI plans to collaborate on this project with the Colorado School of Mines as it has a long-term track record on mechanized excavation technology research.

The current program sponsoring mining companies are Rio Tinto (lead sponsor), Xstrata Nickel and Vale with Ontario Government leveraged funding.

Complementary studies

Projects related to pillar design and underground excavation stability are also funded under this underground construction program. This includes projects on rock fracture modelling and engineering design for economic layouts at depth.

Team Members

Rio Tinto

xstrata
nickel

VALE

Itasca U.S.; Herrenknecht; Wirth; Atlas Copco; ROWA Logistics; Swiss Railway; MIRARCO; Laurentian University; Universities of Toronto and Arizona; UBC; University of Dalian; Colorado School of Mines; others TBD.

Completed

In the field of ground support related to rapid development and sub-level caving, we secured contracts with MIRARCO, Delft University of Technology, University of British Columbia, Itasca - USA, University of Toronto, University of Dalian.

Completed projects

Shaft boring gripper stability

Shotcrete shaft support for mechanized environments



Rio Tinto is driving a “mine of the future” program with mechanized excavation (shaft boring systems (SBS) and tunnel boring systems (TBS). Rio Tinto selected CEMI as the agent for collaborative research leadership in support of high speed development / underground mine construction. Herrenknecht AG designed this SBS model.



GeoRisk

Risk Mitigation for Mining Highly Stressed Ore Bodies at Depth

Work completed and underway

Craig case history
Craig Mine Design review

Structural Guidelines for rockburst-prone ground

GeoHazmap Tool - Mapping the hazard and identifying risks associated with rockburst in underground mines

Site Characterization - Monitoring the changes in rock mass quality due to the process of mining

Burst Support Tool - Helping to address underground rock support needs in dynamic loading conditions

Project Lead

Damien Duff

Purpose and value proposition

The GeoRisk project is focused on evaluating and mitigating the risks associated with underground mining in high stress, structurally complex ore zones. Mining investors are increasingly sensitive to risk when making large capital expenditures. This can be alleviated if the time required to develop a mine and ramp-up production can be shortened and if the most appropriate mining method, means of access, and equipment type can be selected with confidence.

Knowledge transfer

This strategic research project will produce a GeoRisk-manual with findings from completed research and development projects aimed at highlighting current best practices in dealing with risk assessment, mitigation and management within underground highly stressed structurally complex ore bodies. The manual will be a valued tool for use by educators and practitioners alike.

Team Members



THE
ROBERT M. BUCHAN
DEPARTMENT OF MINING



Laurentian University
Université Laurentienne



UNIVERSITY OF
TORONTO
LASSONDE INSTITUTE



IFSCRI Leaders' Workshop



Project Lead

Damien Duff

In Brief

Fault slip control has been identified as one of the most strategic risk factors for deep mining. Hence, the GeoRisk program has been expanded to include a large parallel multi-million, multi-year program with a vision to develop a globally-recognized research initiative to improve fault slip control technologies and techniques for deep underground mines. The initiative is called IFSCRI (International Fault Slip Control Research Initiative).

CEMI is now in the process of attracting funding for this collaborative program which will help to develop safer, sustainable deep mines.



Microseismicity Experimental Design Workshop



Geophysical Technology & Tools Experimental Design Workshop



Structural/Engineering Geology Experimental Design Workshop



Modeling, Data Integration & Mine Design Workshop

Mandate

To execute an internationally-recognized underground research initiative to minimize risks to mines and miners from fault slip events and to improve fault slip control/management techniques.

Objectives

- Better understand the mechanisms causing fault slip in underground mines and produce recommendations on how to minimize the risk to the safety of miners and the economic future of deep mines (minimize investor risk)
- Establish fault slip test sites as “living laboratories” for researchers to carry out projects designed to understand the causes of fault slip events and to develop energy release control techniques
- Provide test sites for technology developers to experiment with and verify new technologies designed to monitor failure processes and energy flow for release in underground mines.

Experimental design workshops

Over the past year, CEMI has hosted a series of Experimental Design Workshops in support of IFSCRI, involving research and industry leaders in seismicity, geophysics, structural geology, data fusion and modeling, as well as mine engineering and ground support. These multidisciplinary roundtable sessions identified research gaps and opportunities which, once addressed, will help to develop technologies and approaches to control the energy release associated with fault slip in high stress underground ore bodies. A final workshop, held with all group leaders, helped to identify and prioritize the IFSCRI program.

For workshop summaries and progress reports please visit:
<http://www.miningexcellence.ca/projects/ifscri/>



Completed

Mineralized vs. un-mineralized breccias in offsets

Sudbury Geological Tour Guidebook

Geophysical Chair hired and in place
- Dr. Richard Smith
NSERC application submitted;
Supervising three graduate students

Project Lead

Damien Duff

Purpose

The Footwall/Offset Geological Studies in the Sudbury Basin ("Footwall") project is focused on developing a greater understanding of the Footwall /Offset geology of the Sudbury Igneous Complex, thereby enhancing future opportunities for exploration success.

Value proposition

Although most of Sudbury's past production is from mines which occur in the so-called "Contact environment," some also occur in the "Offset or Footwall environment", that is, in the rocks immediately below and in juxtaposition to the contact-hosted ores. NSR values in excess of \$1000/t are not uncommon in footwall deposits, making them significantly more valuable than contact ores. Vale's Totten Mine is an example of an Offset-hosted new mine and Xstrata Nickel's new Nickel Rim South Mine is a recent example of one located in both contact and footwall rocks. The Footwall project is focused on more thoroughly understanding the geology of these types of ore deposits to optimize future exploration efforts.

Outcomes

Three projects have been initiated.

They are:

1. Detailed petrologic and geochemical studies of Offset rocks
2. Detailed petrologic and geochemical and partial melting studies of South Range rocks
3. Detailed structural and metamorphic analysis of footwall rocks in the South Range

Team Members



MERC

Laurentian University
Université Laurentienne

xstrata
nickel

QuadraFNX
MINING LTD

VALE

WALLBRIDGE
MINING COMPANY LIMITED



Mine Design to Extract Optimal Mine Value Mine Design Handbook Wiki

Project Lead

Glenn Lyle

Purpose

Create a value driven best practice handbook for underground hard-rock mine design.

www.minedesignwiki.org

Core Team Members

Stephen D. McKinnon

Editor-in-Chief
Queen's University

George McIsaac

Senior Editor
Geology & Mining Evaluation
Consulting

Andrew Dasys

Strategic Development
Objectivity

Value proposition

This wiki handbook is changing how we communicate information and knowledge.

Using the same community model that has allowed Wikipedia to become one of the most successful and valued general information sources, the Mine Design Handbook - Wiki Edition is bringing together the industry's leaders to improve the sharing of mine design expertise.

Driven by the need to capture and build on the years of experience within the industry, the Mine Design Handbook provides a means of combining journal quality reference material with an interactive community.

Outcomes

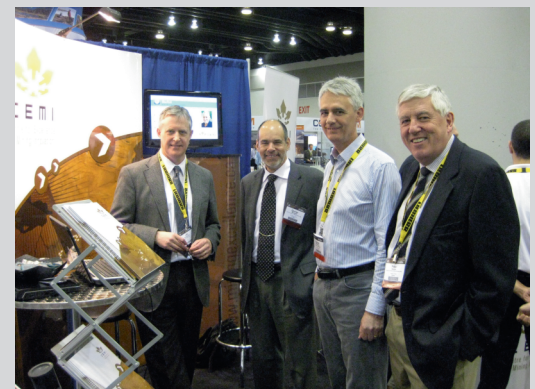
- Allow the best practices to be continually updated.
- Record and preserve the experience of professionals within our industry.
- Aid the training of young professionals during both their university and professional years.
- Emphasize best practices in mine design and the preservation of value in the design process.
- Highlight those gaps within mine design that would benefit from the development of new tools or further research.
- Allow for the discussion of concepts and practices using the capabilities of the wiki structure.
- Combine journal quality reference material with the experience of professionals within our industry.

Invitation

We invite consultants, members of academia and industry, as well as recent retirees, who are interested in making a valuable contribution and learning in the process, to contribute their experience and expertise to writing of one or more sections for the new collaborative online handbook.

**Share the very best of your
experience!**

**Become a contributor with our
community, contact us at
wiki@miningexcellence.ca**



The Mine Design Handbook Wiki was launched during the 2010 CIM conference in Vancouver.



SustainMINE

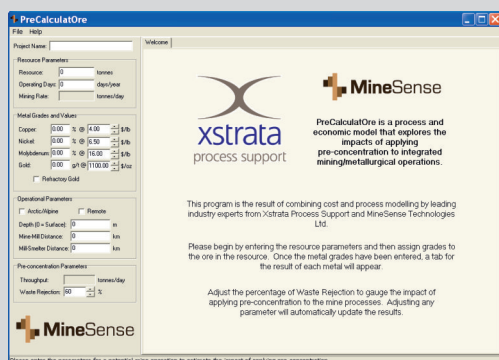
Environmental Studies & Mine Sustainability

Completed

Fugitive Dust Best Management Practice Plan (BMPP) with Golder Associates

Pre-concentration Technical Advisory Committee formed

"PreCalculatOre" tool developed with MineSense Technologies Ltd and Xstrata Process Support (XPS)



Project Lead

Damien Duff

Purpose

Identify relevant and significant research gaps that CEMI can address and use to demonstrate research excellence related to mines and mining sustainability.

Value proposition

Issues related to the environment and the sustainability of mines and mining are of increasing interest to mining companies and to society at large. CEMI has determined through stakeholder consultation sessions that research into topics related to energy usage optimization at mines is of specific relevance. An important additional benefit to this planned work for mining companies is concomitant GHG emission reductions.

Outcomes

Scoping studies have been completed which clearly indicate the opportunities for energy usage optimization at mines, thereby lowering operating costs and contributing to operational longevity and, thereby, sustainability. In support of research excellence in the area of energy cost reduction in mines, Laurentian University and MIRARCO has funded/appointed Dr. Dean Millar as a Research Chair "an energy in mines optimization focus" through the Productivity Enhancement and Risk Management (PERM) program. Commencing in July of 2010, initial goals will be to research and develop the means to significantly reduce energy usage at mines through engineering optimization.

Work is also essentially completed on the construction of a Best Management Practices Plan (BMPP) for dealing with fugitive dust emissions on minesites as well as on a simple computer-based evaluation tool designed to demonstrate the potential benefits of adopting pre-concentration techniques when beneficiating ores. Both offer the prospect of helping to reduce the footprint of mining operations. As well, adoption of pre-concentration techniques presents the added opportunity for significant energy reduction at mines.

Team Members



LCG Energy Management Group, Stratos Environmental, Dennis Kemp Consulting



Project Lead

Allan Akerman

Local Small Medium Enterprises (SMEs) received great support this past year. They are responsive to the mining industry's needs, and tailor their products and services to fill niches that other companies do not participate in. Moreover, they build capacity in the form of employment and knowledge, both of which are important to sustaining mining in Canada. The following projects are among the many collaborative projects featured in the **2010 Innovator Showcase**.

North Baffin Island monitoring project

Symbioticware Incorporated, Baffinland Iron Mines Corporation, and Laurentian University established an embedded network for weather monitoring across North Baffin Island.

Mining and other operations in Canada's far north must deal with not just extreme weather but a climate in flux because of global processes. In the summer of 2009, Symbioticware addressed a number of problems by installing new technology that greatly enhanced the functionality of existing "traditional" monitoring equipment. Symbioticware installed "SymSats" at three existing weather stations located in a north-south transect across north Baffin Island, at the sites of operation of Baffinland Iron Mines, Inc. to enable data retrieval via satellite and set up the cyber-infrastructure to build a broad-ranging environmental monitoring network.



Hoist rope inspection – EMAT integration

On behalf of Vale, CEMI managed the EMAT integration program. C-CORE integrated the functionality from EMAT into the Rotescograph v2 application. The work included the following deliverables: Analysis Pane Functionality, LF Analysis Module, and LMA Analysis Module.

The software integrates the core functionality of the EMAT analysis package (Loss of Metallic Area (LMA) deconvolution filtering and Local Fault (LF) signal enhancement using wavelets) into Rotescograph-2. The new software application will be known as Rotescograph-3.

The new software integration allows the operator access to digital information. In addition, it identifies faults and highlights them both on screen and in tabular form.



New software for assessing risks

Two new software tools were unveiled to assess geotechnical risk and uncertainty by working with Mira Geoscience to develop Geohazmap, a plug-in that works within the Gocad 3D platform, and with Rocscience Inc. on refinements to its Phases2 software.



Photo provided by Symbioticware



Exploratory

University-led Projects

Project Lead

Allan Akerman

Over the past year, a program of investment in generating new mining professionals to prepare Canada for a future in mining has been avidly pursued. This entails the indirect support and service structures that also required HQP (Highly Qualified Personnel). CEMI understands the necessity and has invested in it through its Exploratory Research Program.

The program has been sponsoring university-led research in key niche areas. This support focuses mainly on Masters, PhD and Post Doctoral studies, creating the next leaders in this industry.

Sponsorship is open to all Canadian Universities, and CEMI is continuing to foster these relationships. The following are some of the exploratory projects that are either underway or have just been completed this year. For a complete list of projects see the **2010 Innovator Showcase**.

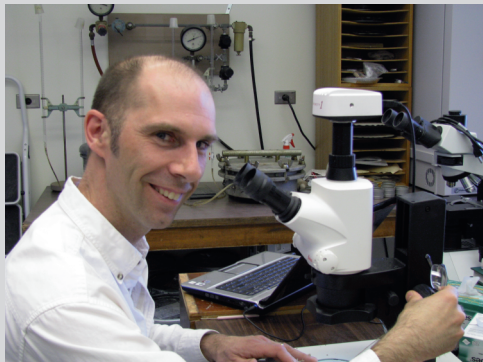


Dr. Peter Ryser (in photo) has been working on a research project entitled Restoring Metal Contaminated Soils which studies the influence of heavy metal stress on drought tolerance of plants.



Dr. Markus Timusk and his graduate student **Jordan McBain** have been working on the Wireless Condition Based Monitoring Project with CEMI in collaboration with Vale. According to Jordan McBain (in photo), "There's such a wide variety of machinery that can't be monitored online, and it's a critical way of keeping operations running and reducing costs of maintenance to avoid critical failure."

The Deep Mine Insulation is another project under the direction of **Dr. Markus Timusk** and his graduate student **Syed Gilani** who studied the idea of insulating rock surfaces in order to reduce the amount of heat coming in, using a foam-type material with insulation properties.



Dr. Daniel Campbell's (in photo) project on the Rehabilitation of Peatlands, Uplands and Habitats employed graduate students in association with DeBeers and Natural Sciences and Engineering Research Council (NSERC) to formulate a protocol for restoring peatlands disturbed as a result of mining activities.

Research Builders

People behind the Research

Dr. Richard Smith has been the CEMI supported Chair in Exploration Geophysics at Laurentian University for 16 months. He has submitted an application for partial support from NSERC through the Industrial Research Chair program. As well, he has initiated a research program, with three students commencing studies in the MSc (Research) program. One student is working on physical properties measurements, another on measuring lateral changes in the conductivity using ground electromagnetic methods, and a third is working on developing a system for a deep penetrating EM system.

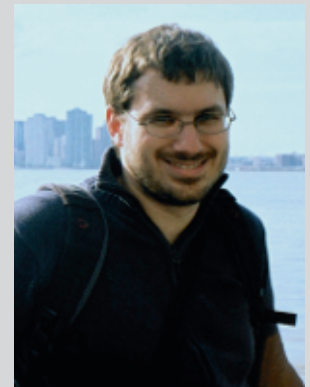
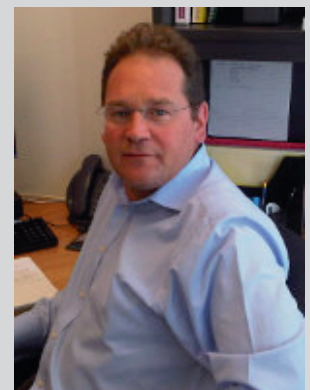
Richard was the Canadian Society of Exploration Geophysicists (CSEG) Distinguished Lecturer for 2009/2010. He visited 23 universities throughout Canada as an ambassador for the CSEG, Laurentian University and CEMI.

Dr. Ming Cai is the Geomechanics Research Chair and Associate Professor at Laurentian University in the School of Engineering. Dr. Cai is collaborating with CEMI on the GeoRisk SRP. This subproject will produce a BurstSupport tool, which can be used by ground control engineers to design dynamic support for bursting ground.

This tool will utilize research findings from the Canadian Rockburst Research Handbook, supplemented with recent development; a new rockburst support design guidebook will also be produced.

Dr. Benoît Valley acts as a scientific advisor on projects related to GeoRisk, ConstrucMline and IFSCRI. His role is to help scope research work in these areas; to facilitate research completion by providing technical support and to evaluate and synthesise research results. Benoît is also supervising the Coleman site characterization and monitoring project (part of GeoRisk) and is co-editing the GeoRisk manual.

Dr. Dean Millar has recently joined Laurentian University as the MIRARCO Research Chair in Energy, Ventilation, and Optimization at the School of Engineering. CEMI looks forward to working with him in the coming year on projects related to energy.



Networking Events

Lecture Series

The Lecture Series features technical presentations on a wide range of mining and engineering topics featuring academic and practicing guest speakers. The series highlights innovative research on topics relevant to the mining industry. Knowledge transfer is one of CEMI's core functions as an institute dedicated to sharing new discoveries and offers the opportunity for further developing connections within the mining community.

Live streaming video of its lecture series is provided for people unable to attend in person and for those in more remote areas, in Northern Ontario and beyond, to gain access to new knowledge. Video coverage of the lectures for online viewing provides exposure around the world. Email webcast@miningexcellence.ca to be added to the mailing list for notification of upcoming lectures and/or if you wish to make a presentation or suggest a future topic.

Moreover, CEMI also hosts an Educational Series. CEMI supported graduate students are offered an opportunity to present their theses to their peers, professors, and key industry representatives. The Educational Series offers an opportunity to celebrate the research efforts of up and coming researchers!



Dr. Sam Spearing

"The future and political threats facing the US coal industry"

Doug Morrison

"The True Value of Mining in Society"

Dr. John McGaughey

"3D and 4D Expert Systems for Exploration Targeting and Geotechnical Hazard Assessment"

Dr. Ming Cai

"The Art of Rock Support in Burst-Prone Ground"

Dr. Paul Dunn

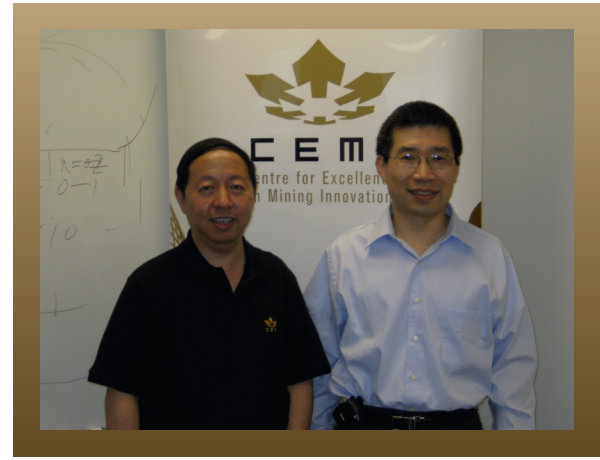
"Thoughts from down under- Australian situation regarding teaching and research"

Dr. Denis Thibodeau

"Ground Control Strategies for Burst-prone Rock Conditions at Vale Ontario Division"



Ten Laurentian University students attended a luncheon in their honour hosted by CEMI for demonstrating leadership and excellence in engineering. Their accomplishments included a first place award in the Ontario Engineering Competition and the Canadian Engineering Competition, as well as the Kossatz Scholarship and Stantec/McIntosh Engineering Scholarship. CEMI actively supports several universities in undertaking research and transferring knowledge to the mining community.



Dr. Chunan Tang was one of CEMI's **Visiting Scholars**. This program hosts international or national experts or academic scholars as intellectual resources for CEMI program components and as contacts for HQP development. The program is offered in collaboration with departments of Laurentian University (LU) and the mining industry.

The Visiting Scholar Program offers prospective visitors a unique opportunity to actively participate in applied research related to CEMI's strategic direction and to work in collaboration with sponsor companies.



Dr. Sam Spearing, Associate Professor, Dept of Mining and Mineral Resources Engineering, **Southern Illinois University, Carbondale**, led a group of future mining engineers on an educational tour on hard rock mining in Ontario. CEMI led the tour while the students and Dr. Spearing were in the Sudbury area. For most of the students, this underground tour was their first experience underground in a hard rock mine. Dr. Spearing also guest lectured for the Lecture Series on the US coal industry.



CEMI attended the **CIM conference** to highlight member companies through in-booth participation; showcased five flagship projects to conference delegates; and held one-on-one meetings with key decision makers.

Through conferences such as CIM, CEMI meets its role as an Institute to facilitate and accelerate mining innovation beyond Ontario and Canada.

Membership

Join our global network of experts!

CEMI invites you to join our collaborative research network which serves the needs of the mineral resources industry and engages applied research and service providers.



Individuals, companies, institutions, and not-for-profit entities are invited to join the CEMI network through membership, available in two categories:

Innovator (R&D Provider)
Corporate Sponsor (R&D Supporter)

The CEMI Advantage

Through collaborative, innovative mining research and a wide team of networked researchers, CEMI is helping to achieve step-change advances with a focus on issues of critical importance to the mining industry.

Membership Offers

The opportunity to be a part of the solution to some of mining's most pressing challenges.

Industry-focused projects that add value and have potential to generate economic benefits.

Access to interdisciplinary, highly capable and experienced research teams.

Increased company profile through CEMI-sponsored marketing and events.

Training discounts on short courses and workshops.

INNOVATOR MEMBER

“Being a CEMI Member has given us expert knowledge into mining requirements and the opportunity to turn our innovation into a viable product for the mining industry.”

~ Kirk Petroski, President and CEO - Symbioticware

CORPORATE SPONSOR

“CEMI has a proven track record to deliver key results to industry. Their experienced team of project managers, combined with the unique ability to link the right research organizations and consultants, adds value to our strategic underground mining research projects.”

~ Fred Delabbio, General Manager Innovation
- Underground, Rio Tinto

Visit us at www.miningexcellence.ca/membership/

INNOVATOR MEMBERSHIP

PROFILE

You are a provider of research, services or technology. Innovators can come from the private, public or not-for-profit sectors, including R&D institutes, universities, consultancies, technology developers, and mining & exploration companies.

BENEFITS

Network with other members and Corporate Sponsors

Team up with CEMI to jointly approach corporate sponsors for support specific to your project

Access industry and government support

Build your project team

Be first to know about calls for proposals, events and professional development opportunities

Access select data and publications

INVESTMENT

In-kind participation through time, datasets, and/or facility & equipment sharing, delivery of short courses & seminars, and participation in research planning workshops

Members also receive discounts on short courses and other professional development events

CORPORATE MEMBERSHIP

PROFILE

You are a company / organization investing funds in support of a research or development project, or general sponsorship of a CEMI research program. Members also participate through in-kind contributions of data, access to mines and facilities, and staff time.

BENEFITS

Become **eligible** to participate in CEMI's corporate-level planning through Board or Steering Committees (subject to approval)

Support step-change research to help develop the mines of the future

Reduce risk associated with innovative R&D

Leverage your R&D investment

Gain streamlined access to research delivery groups

Access research results, datasets, and publications from CEMI-sponsored projects

PLUS! Select projects are eligible for proposal development and project management support

INVESTMENT

Invest in...

People: \$20-50k / yr

Sponsor students or researchers through a grant contribution

Program: \$50k / program per year

Join a Strategic Research Program (SRP) and co-sponsor/ influence ongoing work. This general designation provides access to research results from projects undertaken in one SRP for every \$50k invested

Create your own...

Project: \$100-200k+ / yr

Help define and participate in a project that interests you, in an area that aligns within CEMI's defined research focus areas

Focus Area: \$200k+ / yr

Define and guide a new research topic within CEMI (five year pledge)



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Financial Statements

Statement of Financial Position

April 30, 2010, with comparative figures for 2009

	2010	2009
Assets		
Current assets:		
Cash	\$ 533,319	293,709
Accounts receivable	2,302,898	180,814
Prepaid expenses	28,420	15,551
	2,864,637	490,074
Capital assets	172,933	199,006
Investments	9,119,287	10,933,212
	\$ 12,156,857	11,622,292
Liabilities and Net Assets		
Current liabilities:		
Accounts payable and accrued liabilities	\$ 1,376,370	346,850
Net assets:		
Unrestricted	10,607,554	11,076,436
Equity in capital assets	172,933	199,006
	10,780,487	11,275,442
Commitments		
	\$ 12,156,857	11,622,292

Statement of Operations and Changes in Net Assets

Year ended April 30, 2010, with comparative figures for 2009

	Unrestricted	Equity in Capital Assets	2010 Total	2009 Total
Revenue:				
Industry founding members	\$ 2,000,000	-	2,000,000	2,000,000
Community Adjustment Fund	2,024,156	-	2,024,156	-
Research and other revenue	1,051,639	-	1,051,639	436,245
Investment income	81,233	-	81,233	149,036
	5,157,028	-	5,157,028	2,585,281
Expenses:				
Salaries and benefits	710,381	-	710,381	540,060
Projects	1,436,927	-	1,436,927	354,477
Travel	164,060	-	164,060	45,237
Insurance	18,664	-	18,664	18,403
Rent	71,661	-	71,661	142,872
Advertising and promotion	24,798	-	24,798	39,811
Office and general	214,818	-	214,818	81,907
Professional fees	9,787	-	9,787	13,626
Contract services	923,653	-	923,653	363,555
Community Adjustment Fund - Partners	1,749,468	-	1,749,468	-
- Project Management	274,688	-	274,688	-
Amortization of capital assets	-	53,078	53,078	48,387
	5,598,905	53,078	5,651,983	1,648,335
Excess (deficiency) of revenue over expenses before transfers	(441,877)	(53,078)	(494,955)	936,946
Transfer for capital assets	(27,005)	27,005	-	-
Net assets, beginning of year	11,076,436	199,006	11,275,442	10,338,496
Net assets, end of year	\$ 10,607,554	172,933	10,780,487	11,275,442



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