



Exploration Students Present Research to Industry

On November 30, 2011, CEMI hosted an opportunity for CEMI sponsored and supported students to come together to speak to the mining community about their Exploration and Geophysics related research projects. Earlier this year, CEMI hosted a similar event for the students working on GeoRisk related research. CEMI is proud to work with the next generation of up and coming researchers.



From left to right: Devon Parry, Craig Stewart, Oladele Olaniyan, R. Mohan Srivastava, Josh Lymburner, Michal Kolaj, Fabio Cafagna, Taus Joergensen.

Taus Joergensen (PhD candidate) presented,

“Identification of Pyroxene Hornfels Facies Mafic Rocks within the Metamorphic Aureole of the South Range of the Sudbury Igneous Complex, On, Canada”

Fabio Cafagna (PhD candidate) presented, “Experimental Study of the Role of Semi-Metals on the Mobility of PGE”

Oladele Olaniyan (PhD candidate) presented, “Qualitative and quantitative integrated geophysical investigation of the Sudbury structure”

Josh Lymburner (MSc) presented, “A Deep Electromagnetic Tool”

Michal Kolaj (PhD candidate) presented, “Mapping Laterally Varying Conductance Using Electromagnetic Gradients”

Devon Parry (MSc) presented, “Borehole Geophysics: Downhole Logging and Comparison with Handheld Physical Property Measurements”

Dr. Bruno Lafrance presented on behalf of **Dr. Tsilavo Raharimahefa** (PDF) “Structural, Metamorphic, and U-P Geochronological Evolution of the Southern Province, Sudbury, Canada”

As an added bonus, **R. Mohan Srivastava** President, Benchmark Six, presented a keynote address on “Fracture modeling: New ideas for mineral deposit development and production planning”.

Fractures play an important role in many aspects of mineral deposits, from grass roots exploration through development and production. In many mineral deposits, they serve as the “backbone” for understanding where mineralized fluids, travelling through permeable pathways, precipitated economically viable concentrations of metals. Fractures also play an



important role in understanding geotechnical studies of mine designs, from assessing suitable slopes for pit walls to assessing the stress and strain in underground workings. Fracture network models are also critical in modeling groundwater flow

in and around mines.

Despite the central role of fractures in many aspects of development, planning and production, there are few tools for building 3D fracture network models that honour the many different types of fracture data available to us: direct observations of traces on the



ground surface, and in underground working; observations of location and orientation in drill holes; data from monitoring of micro-seismic activity. In the past decade, Canada's nuclear waste management program has developed new tools for building 3D fracture network models that can honour much of the available data and that can be used for flow modeling, for assessment of geotechnical risks and for other studies where uncertainty in fracture geometry plays a role.

CEMI lectures are recorded and are streamed live for world wide viewing. Visit our website to view this and other lectures. Contact us if you have a suggestion on a topic or guest speaker.

CEMI launches new Structural Geology Guidelines Manual for use in burst-prone underground mines



CEMI is proud to announce the completion of the **Structural Geology Guidelines for Aiding Characterization of Deep Mining Fault Behaviour**. This comprehensive manual, prepared in partnership with Golder Associates and Queen's University, will be available for purchase on the CEMI website

in January 2012.

This manual is intended to provide guidelines for improving current levels of structural geologic data collection and evaluation in rockburst-prone areas in underground mines. It should help geologists and engineers in these mines (or planned mines) to better work together to understand and interpret rock mass conditions associated with faulting and fault slip type seismicity and the impact they can have on underground mine design and planning.

It is anticipated that the guidelines will be primarily applicable in two key areas:

1. In known structurally complex, high stress, rockburst-prone mine settings; and
2. In active and/or planned mines where rockbursting or disruptive seismic events are not currently known but which, because of the geologic environment and/or mining depth, could eventually experience potentially dangerous energy release conditions.

Visit the CEMI website to purchase your copy or to **download for free** the Table of Contents and Executive Summary. www.miningexcellence.ca

CEMI hosts 4th AGM

On October 12th, 2011, CEMI hosted its 4th AGM and presented four of its strategic research programs: GeoRisk, Ventilation on Demand, the Rio Tinto Centre for Underground Mine Construction, and Smart Underground Monitoring and Integrated Technologies (SUMIT) for Deep Mining which highlighted technical achievements and work in progress.

CEMI welcomes its newest board member, Karen Clarke-Whistler, Chief Environment Officer, TD Bank Financial Group. In addition, Sam Marcuson, Vice President, Vale, has been appointed as the new Chair of Board of Directors.



CEMI wins Judges' Choice

On September 27th, 2011, CEMI was presented with the Judges' Choice Award at Northern Ontario Business Awards Gala in Sudbury, ON. CEMI would like to thank Northern Ontario Business, our award sponsor, Morris Modular, and our nominator, BESTECH. This recognition acknowledges and encourages us to continue our efforts in seeking active collaboration with Northern Ontario-based businesses. We will work with the City of



Greater Sudbury and SAMSSA to identify potential innovations, link them to researchers who are able assist in bringing new ideas to the market, and thereby increase employment opportunities in Northern Ontario. [Judges' Choice Profile & Video](#)

Innovation & Prosperity Office

The establishment of an Innovation & Prosperity Office (IPO) was made possible by a contribution of start-up funds by the Greater Sudbury Development Corporation (GSDC) in the amount of \$75,000. The Office assists in developing multi-partner, funding proposals and it will seek out and funnel R&D business opportunities to innovators in Sudbury's mining community and Region at large. To this end, CEMI will identify innovation opportunities focus R&D funding to accelerate pre-commercialization activities.

Recently, the IPO partnered with **Mansour Mining Technologies** and held a workshop gathering key members from industry to identify what they felt were the pressing issues that industry would like addressed in the short and longer term in ground control and support.

The IPO is an extension of CEMI whose core focus is to strengthen and aid in delivering the needs of SMEs in the Greater Sudbury Area. The office will identify opportunities for growth and expansion for local SMEs. We are looking to discuss potential project ideas with you.

Please contact **Bora Ugurgel**, Innovation and Prosperity Office Coordinator, at 705-561-9746 or email at bugurgel@miningexcellence.ca to discuss how we can help develop your innovative ideas and turn them into valued resources to the mining world.

Chair in Holistic Mining Practices

One crucial component of a globally competitive organization is stability and visionary leadership. As

Chair in Holistic Mining Practices and Vice President of CEMI, Douglas Morrison joins CEMI to implement a

visionary five-year Research and Development plan that will assist in sustaining local mines, retaining jobs, opening new mines and creating new jobs. With an investment in the amount of \$823,000 by the Northern Ontario Heritage Fund in a Research Chair for Holistic Mining Practices, CEMI will be able to sustain and expand its mining innovation role.

Smart Underground Mining and integrated Technology (SUMIT) for Deep Mines

In 2010, CEMI submitted a funding application to the Ontario Research Fund and in June of 2011 was awarded \$2.24 million towards a total project value of \$6.7 million for the SUMIT program.

The SUMIT program focuses on three major challenges associated with deep underground mining:

FAULT SLIP CONTROL: Superior mine design and planning; improved ground behaviour and energy release control when mining at depth; unprecedented integration and multi-disciplinary usage of data.

RAPID UNDERGROUND DEVELOPMENT: Rockmass behaviour and machine performance assessment in response to the use of mechanized excavation and material handling systems, through enhanced data collection/management strategies.

MINE SUSTAINABILITY: Reduced mining footprint and improved cost effectiveness through new energy optimization techniques and strategies.

CEMI's patron mining companies (Vale, Xstrata Nickel and Rio Tinto), in addition to providing significant cash and in kind contributions to this project, have agreed to allow us to use their underground mines as "living laboratories" for the SUMIT project, thereby maximizing the chances of research success and providing valuable real-world outcomes for all stakeholders.



Cutting edge data integration and dissemination techniques are being developed to not only ensure the near real time distribution of relevant datasets to designated researchers but to speed up the research outcome delivery process itself. Global leaders in information technology have been contracted to provide system design advice and will likely remain involved over the course of the entire SUMIT project.



(Front left to right) Back row: Keith Bullock, Peter Kaiser, Mark Frayne, Jean Hutchinson, Claire Samson, Erik Eberhart, Jane Djivre, Benoit Valley, Ming Cai, Douglas Morrison; Front row: Richard Smith, Denis Thibodeau, Damien Duff, Brad Simser, and Bernd Milkereit. Missing from photo: Steve McKinnon, Mark Diederichs, Kaiwen Xia, Maurice Dusseault, John Harrison, John Hadjigeorgiou, Paul Young, Douglas Schmitt, and Gary MacSparran

Under the management of CEMI, solution teams of well known researchers from three of Ontario's most renowned university mining research groups will work collaboratively to address research questions. These three teams will be led by Dr. Peter Kaiser at Laurentian University; Dr. Mark Diederichs at Queen's University and Dr. Paul Young at the University of Toronto. In addition to their teams, the effort will be supported by additional researchers located at the universities of Carleton, Waterloo, Alberta and British Columbia, and in excess of 75 person years of student training will be created leading to a large number of scientific and engineering publications being generated.

Tools and guidelines will be produced for use by industry and researchers alike to assist in addressing

the technology needs of deep underground mines leading to better risk management practices and enhanced investor confidence.

Ventilation On Demand (VOD)

CEMI, in collaboration with Xstrata Nickel, Vale, CANMET and Objectivity, has completed the first phase of a VOD program aimed at gaining a better understanding of how VOD systems affect the underground working environment from perspectives of operational control, economics, productivity and industrial hygiene. The project was designed to address three key components of VOD systems: validate the business case for VOD; understand the work required to ventilate air quality requirements instead of air quantity requirements; and capture ventilation air sensor performance to understand required sensor locations, density, and maintenance requirements.

This project comprised installations of new equipment at the Nickel Rim South Mine (Xstrata Nickel) and at Vale's Coleman Mine, and the monitoring of system components at these mines during operations. The equipment operated as designed and valuable data was recovered from both mines. The initial data interpretation has already provided invaluable insight into the challenges and potential opportunities associated with operating VOD systems. Due to the short time line (18 mos), CEMI assembled and collaborated with a team of Sudbury area experts, comprised of industry, government, small medium enterprises (SMEs) and original equipment manufacturers (OEMs), and leveraged \$4.25 million dollars in financial contributions from Vale and Xstrata Nickel from Industry Canada's Community Adjustment Fund (CAF) for a combined project budget of \$8.5 million.

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performance to understand required sensor locations, density, and maintenance requirements.

The project supported and augmented Vale and Xstrata Nickel's existing VOD programs by installing monitoring equipment at Vale's Coleman Mine (Ore Body 153) and Xstrata Nickel's Nickel Rim South Mine. The team completed field at both mine sites and lab studies to analyze sensors for diesel emissions, the effects of pressure on sensors, and cross contamination of gas sensors. The field studies and the data collected from the underground monitoring allows for a detailed assessment and analysis of VOD capabilities under differing system operating characteristics.

Objectivity developed VREX, a financial model that links a mine's production with its ventilation network. This model can simulate the demands of the mine's production and compare it to the capabilities of the ventilation network. This allows for multiple scenarios of VOD to be evaluated. The VREX model makes it possible to determine and identify where VOD can bring the maximum benefit to a mining operation, and help prioritize where capital should be invested.

The VOD project led to the establishment of a new company, *Objectivity*, which developed the analytical software. The project also assisted in the development and expansion of another SME, *Symboticware*, which applied its open protocol technology (*Symbot*) to collect valuable data from the mines. The collaboration with other local SMEs made this project a broadly-based community project. Finally, the spirit of collaboration amongst all participants, demonstrated that it is possible for the community of mine service companies to work together to benefit the mining industry. It serves to demonstrate recognition of the importance of ventilation to the future of the mines in Northern Ontario and the Sudbury Basin in particular.

It was found that tailpipe sensors for continuous operation can capture engine operation parameters and emissions, which can be related back to lab tests.

This will allow for the prediction of diesel engine emissions at varying operating conditions and field monitoring will confirm operating conditions. The sensors identified that there are flow rate, cross sensitivity maintenance and placement issues. VOD cost benefits can be calculated using the VREX modeling tools. While VOD systems will reduce energy consumption, the biggest opportunity is in re-directing air potentially allowing for productivity gains and increasing overall energy efficiency. There is an opportunity to implement lessons learned from the VOD project into future mine designs. Currently available VOD systems can alter and monitor flow rates, and many new areas for future work have been identified around how we use these commercial systems common for all users. The first phase of VOD has positioned the mining community to better understand the current ventilation practices, and identify the work required to advance the necessary knowledge to significantly improve how a mine can operate efficiently.

The next phase of the work (VoD2) will include ventilation for production; engine emissions monitoring, the creation of a best-practices guide; and additional in mine monitoring requirements. A multi-company consortium is being established to address these areas in the next phase of this project which is expected to be a 2-3 year, multi-million dollar project managed by CEMI in collaboration with industry, CANMET and SMEs.

Key contributors and collaborators included Vale, Xstrata Nickel, NRCAN/CANMET, *Objectivity*, *Labrecque Technologies*, *Caterpillar*, *Symboticware*, *Bestech*, and *Simsmart*.

Check out our Innovation Showcase featuring some of our flagship projects and collaborative activities.

