The Deep Mining 2014 Committee and the Australian Centre for Geomechanics have worked for many months with industry to generate an exciting and focussed technical programme that brings together leading visionaries, strategists and experts from local and global industries.

The objective of this series of international seminars is to promote discussion and documentation of the latest technologies and practices of mining in deep and high stress environment. Since inception, the technical content has focussed on geomechanics issues with themes such as seismic monitoring, ground support and numerical modelling dominating the proceedings. Nevertheless, the seven seminars also offer an important contribution to the more traditional mine engineering themes of deep mine planning and design, as well as ventilation.

Associate Professor Marty Hudyma, Laurentian University, and the ACG team look forward to joining with our Canadian friends and peers to host Deep Mining 2014 in Sudbury.
CONFERENCE PROGRAMME*

7:00 Registration

8:00 Welcome and Introduction Marty Hudyma, Laurentian University, Canada

8:15 OPENING ADDRESS: Learning from each other Samantha Espley, Vale Canada Ltd., Canada

8:30 KEYNOTE ADDRESS: Kidd Mine – dealing with the issues of deep and high stress mining – past, present, and future DB Counter, Glencore Canada Corp., Canada

Session 1  Plenary session one

9:00 Towards continuous bulk production from below 2.5 km D Morrison, H Parsons, A Alerman, Centre for Excellence in Mining Innovation, Canada

9:30 Mitigation strategies for mining in high stress sill pillars at Coleman Mine – a case study S Townsend, A Sampson-Forsythe, Vale Canada Ltd., Canada

10:00 Practical applications of a rockburst database to ground support design at LaRonde Mine P Turcotte, Agnico Eagle Mines Ltd., Canada

10:30 Morning Break

Session 2  Case studies

11:00 A comparison of shallow and deep mining T Anderson, KGHM International Ltd., Canada

11:30 Rock mechanics tools for mining in high stress ground conditions at Nickel Rim South Mine A Jabouit, B Simser, Sudbury Integrated Nickel Operations, Glencore Company, Canada

12:00 From high stress to de-stressed – mining in changing conditions P Bergström, K Sahala, First Quantum Minerals Ltd., Finland; M Hakala, KMS Hakala Oy, Finland

12:30 Lunch

Session 3  Monitoring

13:30 Deformation-based support selection for tunnels in strainburst-prone ground PK Kaiser, Laurentian University, Canada

14:00 The operational and laboratory aspects of a thin spray-on liner PK Börg-Jensen, Luossavaara-Kiirunavaara AB, Sweden; G Swan, Rock Mechanics & Mine Design, Canada

14:30 Load-deformation behaviour of a deformable rockbolt and anchors under dynamic loading FC Charette, Normet Canada Ltd., Canada; AJ Hytt, Yieldpoint Inc., Canada; B Voyerelle, T-Anderson, Natural Resources Canada, Minerals and Metals Sector, CanmetMINING, Canada

15:00 Afternoon Break

Session 4  Ground Support

15:30 Empirical and numerical investigation on the behaviour of foliated rock masses under high stress conditions E Karampinos, J Hadjiijiagourou, University of Toronto, Canada; P Turcotte, M-M Dufre, F Mercier-Langevin, Agnico Eagle Mines Ltd., Canada

16:00 Mine-scale numerical modelling, seismicity and stresses at Kiirunavaara Mine, Sweden J Vatcher, Luleå University of Technology, Sweden; SD McKinnon, Queen’s University, Canada; J Stjbegg, Itasca Consultants AB, Sweden


17:00 Day Close

www.deepmining2014.com

* This programme was correct at time of brochure printing. For updates please visit www.deepmining2014.com.
**CONFERENCE PROGRAMME**

**Session 8**  
Plenary session two

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Venue</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>4D data management and modelling in the assessment of deep underground mining hazard</td>
<td>Palladium North and Centre</td>
</tr>
<tr>
<td>9:30</td>
<td>Seismic risk and hazard management at Kidd Mine</td>
<td>BV Dilsley, Gencore Canada Corp., Canada</td>
</tr>
<tr>
<td>10:00</td>
<td>Observational studies of the rock mass response to mining in highly stressed gold mines in South Africa</td>
<td>Palladium South</td>
</tr>
<tr>
<td>10:30</td>
<td>Morning Break</td>
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</tr>
<tr>
<td>11:00</td>
<td>Geostatistical interpolation of estimated RQD values and its use in geomechanics design considerations – a case study</td>
<td>Palladium North and Centre</td>
</tr>
<tr>
<td>11:30</td>
<td>Estimation of in situ stress using the memory technique for deep mining PM Dight</td>
<td>Palladium South</td>
</tr>
<tr>
<td>12:00</td>
<td>The Sudbury Basin stress tensor – myth or reality?</td>
<td>Palladium North and Centre</td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch</td>
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<tr>
<td>13:30</td>
<td>Strainburst hazard awareness for development miners</td>
<td>Palladium South</td>
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<tr>
<td>14:00</td>
<td>Shear rupture – two case studies from a deep mine</td>
<td>Palladium South</td>
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<tr>
<td>14:30</td>
<td>The statistical presentation of seismicity for appreciating seismic hazard</td>
<td>Palladium South</td>
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<tr>
<td>15:00</td>
<td>Afternoon Break</td>
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<tr>
<td>15:30</td>
<td>Simulation of mining-induced seismicity using the Salamon–Linkov method</td>
<td>Palladium South</td>
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<tr>
<td>16:00</td>
<td>3D velocity model with complex geology and voids for microseismic location and mechanism</td>
<td>Palladium South</td>
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<tr>
<td>16:30</td>
<td>The induced mechanism of pillar rockbursts in deep hard rock mines</td>
<td>Palladium South</td>
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<tr>
<td>17:00</td>
<td>Day Close</td>
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</tbody>
</table>

**Session Chair**  
Professor John Hadjigeorgiou, University of Toronto, Canada

John's teaching, research and consulting activities are in the areas of rock characterisation, slope stability, tunnelling, reinforcement and support, and mine design. He has design over 20 years of pertinent experience in North America, Canada, Australia and Europe, working in mining and geotechnical engineering. John is a past recipient of the John Franklin Award in Rock Mechanics from the Canadian Geotechnical Society and the Rock Mechanics Award from the Canadian Institute of Mining and Metallurgy.

**KEYNOTE ADDRESS:** Has research and development contributed to improvements in safety and profitability of deep South African mines?  
RJ Durheim, University of the Witwatersrand and CSIR, South Africa

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**Conference Dinner – Science North Vale Cavern | 100 Ramsey Lake Road | Ontario, Canada**

The global mining industry requires its professionals to maintain and further their professional competence and knowledge. Professional Development (PD) is crucial to career progression and personal growth. ACG event attendance may contribute towards your PD.

### Parallel Sessions

**Session 15** Plenary session three

- **9:00** Rock support testing in Luossavaara-Kirunavaara AB’s underground mines, Sweden
  - E Swedberg, F Thyin, J Törni, Luossavaara-Kirunavaara AB, Sweden; A Eltzeberger, Luleå University of Technology, Sweden
- **9:30** Analysis and numerical modelling of dynamic ground support based on instrumented full-scale tests
  - A Roth, Geobrugg AG, Switzerland; M Cala, AGH University of Technology and Science, Poland; R Brändle, Geobrugg AG, Switzerland; E Rorem, Geobrugg North America, USA
- **10:00** The influence of change in mining and ground support practice on the frequency and severity of rockbursts
  - P Morissette, J Hodjigeorgiou, University of Toronto, Canada; AR Punkkinen, DR Chinnasami, Vale Canada Ltd., Canada

### Conference Programme*

**DAY THREE – 18 SEPTEMBER 2014**

**Palladium North and Centre**

**Session Chair** Winthrop Professor Phil Dight, Australian Centre for Geomechanics, The University of Western Australia, Australia

Phil has been involved with the development and design of ground support for mining applications since 1975. Phil has extensive consulting experience in the geotechnical aspects of the mining industry, and has worked on open pit and underground metaliferous mining problems. Much of that early research work has now been formalised in the literature by others. Phil joined the ACG in 2008 and has since been working on stress memory effects in rocks, ground support applications and slope stability problems.

**Keynote Address**: The continuing challenge to provide adequate ventilation and a safe environment in deep mines
- SG Hardcastle, Natural Resources Canada, Minerals and Metals Sector, CanmetMINING, Canada

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 16 Ground support (2)</th>
<th>Session 17 Ventilation (1)</th>
<th>Session 18 Ground support (3)</th>
<th>Session 19 Ventilation (2)</th>
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<tbody>
<tr>
<td>15:30</td>
<td>Conference Farewell</td>
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<tr>
<td>9:00</td>
<td>Rock support testing in Luossavaara-Kirunavaara AB’s underground mines, Sweden</td>
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<tr>
<td>9:30</td>
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<tr>
<td>10:00</td>
<td>The influence of change in mining and ground support practice on the frequency and severity of rockbursts</td>
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</table>

**Session Chair** Chantale Doucet, Agnico Eagle Mines Ltd., Canada

- **11:00** Development in deep, hard rock mines – beyond 10 m/day
  - D Morrison, A Akerman, H Parsons, Centre for Excellence in Mining Innovation, Canada
- **11:30** Ultra rapid strength development in dry-mix shotcrete for ultra rapid support in challenging mining conditions
  - J-D Lemay, M Jolin, Université Laval, Canada; R Gagné, Université de Sherbrooke, Canada
- **12:00** Development of a rapid strength gain dry-mix shotcrete using calcium sulfo-aluminate cement for mining and tunnelling applications
  - S Reny, N Ginoce, King Packaged Materials Company, Canada

**Session Chair** Chantale Doucet, Agnico Eagle Mines Ltd., Canada

- **13:30** Examples of ground support practice in challenging ground conditions at Vale’s deep operations in Sudbury
  - M Yao, A Sampson-Forsythe, AR Punkkinen, Vale Canada Ltd., Canada
- **14:00** Use of cable bolts to reinforce the hanging pillars and improve the ore recovery when stopes are mined using double top sills at Vale’s Copper Cliff Mine
  - DR Chinnasami, YieldPoint Inc., Canada; FC Charette, Normet Canada Ltd., Canada; AJ Hyett, YieldPoint Inc., Canada
- **14:30** Enlightening bolts
  - BI Hyett, YieldPoint Inc., Canada; FC Charette, Normet Canada Ltd., Canada; BI Forbes, Queens University, Canada; AC Engbroten, YieldPoint Inc., Canada
- **15:00** Economic and productivity comparison of ground support for rockburst prone and squeezing ground conditions
  - LJ Hayman, Coffey International Ltd., Australia

**Session Chair** Dr Patrick Andrieux, Itasca Consulting Group, Inc., USA

- Dr Andrieux is a mining engineer with 30 years’ experience at surface and underground operating sites, research and development, instrumentation, technical services and support, and consulting. His areas of specialisation are mine design and sequencing, geomechanics, ground control and ground support, drilling and blasting, and blast monitoring. He is a registered professional engineer in Canada in the provinces of Ontario and Quebec, and a designated consulting engineer in the Province of Ontario.

**Session Chair** Dr Stephen Hardcastle, CanmetMINING – Natural Resources Canada, Canada

- Dr Hardcastle is the head of ventilation research with CanmetMINING, a division of Natural Resources Canada. He attended Nottingham University, graduating with a BSc and PhD in mining engineering. Dr Hardcastle has now amassed over 31 years of experience in underground environmental issues with the Canadian government and is also an adjunct professor with the Laurentian School of Engineering in Sudbury. He has worked across Canada assisting the base and precious metal industries as well as salt, potash uranium, coal and rare earth mines.

**Session Chair** Dean Millar, MIRARCO / Laurentian University, Canada

- **12:00** morning break
- **13:30** Overcoming high temperature water ingress in deep shaft mining
  - MT Swanson, Cementation USA, Inc., USA; TM Goodell, Rio Tinto, USA
- **14:00** Development in deep, hard rock mines – beyond 10 m/day
  - D Morrison, A Akerman, H Parsons, Centre for Excellence in Mining Innovation, Canada
- **14:30** Ultra rapid strength development in dry-mix shotcrete for ultra rapid support in challenging mining conditions
  - J-D Lemay, M Jolin, Université Laval, Canada; R Gagné, Université de Sherbrooke, Canada

**Session Chair** Dr Stephen Hardcastle, CanmetMINING – Natural Resources Canada, Canada

- **14:00** Overcoming high temperature water ingress in deep shaft mining
  - MT Swanson, Cementation USA, Inc., USA; TM Goodell, Rio Tinto, USA

**Session Chair** Dean Millar, MIRARCO / Laurentian University, Canada

- **15:30** Conference farewell

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**Collaborating Organisations**

**ACG Australian Centre for Geomechanics**
**University of Toronto**
**University of Western Australia**

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**Professional Development**

The global mining industry requires its professionals to maintain and further their professional competence and knowledge. Professional Development (PD) is crucial to career progression and personal growth. ACG event attendance may contribute towards your PD.
COMMITTEES

Local Organising Committee
Luc Beauchamp  Workplace Safety North, Canada
Dr Philip Dirige  Laurentian University, Canada
Samantha Espley  Vale Canada Ltd., Canada
Charles Graham  CAMIRO Mining Division, Canada
Associate Professor Marty Hudyma  Laurentian University, Canada
Gary Poxleitner  SRK Consulting (Canada) Inc., Canada
Brad Simser  Sudbury Integrated Nickel Operations, Canada
Dr Mike Yao  Vale Canada Ltd., Canada

International Advisory Committee
Professor John Hadjigeorgiou  University of Toronto, Canada
Winthrop Professor Yves Potvin  Australian Centre for Geomechanics, Australia
Emeritus Professor Dick Stacey  University of the Witwatersrand, South Africa

CONFERENCE VENUE

Radisson Hotel Sudbury
85 Ste. Anne Road  |  Ontario, Canada
Tel: +1 (705) 675-1123
sales@radissonsudbury.com
www.radissonsudbury.com

Science North Vale Cavern
100 Ramsey Lake Road  |  Ontario, Canada
Tel: +1 (705) 522-3701
www.sciencenorth.ca

CONFERENCE CHAIR

Dr Marty Hudyma
Associate Professor,
Laurentian University, Canada

OPENING SPEAKER

Samantha Espley
Vale Canada Ltd., Canada
Opening Address: Learning from each other

KEYNOTE SPEAKERS

David Counter
Glencore Canada Corp., Canada
Keynote address: Kidd Mine – dealing with the issues of deep and high stress mining – past, present, and future

Professor Ray Durrheim
University of the Witwatersrand and CSIR, South Africa
Keynote address: Has research contributed to improvements in safety and profitability of deep South African mines?

Dr Stephen Hardcastle
Natural Resources Canada, Minerals and Metals Sector, CanmetMINING, Canada
Keynote address: The continuing challenges to provide adequate ventilation and a safe environment in deep mines

www.deepmining2014.com
This one day course consists of two parts:

Part one covers basic principles of seismic monitoring and conventional applications of the data for mining practices. This comprises an overview of seismic monitoring systems and data processing techniques. Special attention is paid to the limitations of seismic data – pollution of seismic catalogues by blasts, uncertainty in location of seismic sources, effect of sensor type and usable bandwidth on source parameters, sensitivity of source mechanisms to sensor orientations. The data processing techniques and applications are illustrated using IMS software.

Part two of the course is focused on one specific application - integration of stress modelling with seismic monitoring. This includes forensic analysis of rockbursts and large seismic events, validation and improvement of numerical stress models using seismic data, simulation of seismicity and incorporation of seismic data in numerical models.

The course attendees will receive a temporary licence of IMS software, which can be downloaded from our web site and installed on their laptops. The demonstration seismic databases and corresponding 3D visualisation/analysis projects will be provided as well.

We trust the course will help mining geotechnical engineers comprehend both the limitations and benefits of seismic monitoring for their routine tasks.

**Presenters**

Dr Dmitriy Malovichko  
_institute of Mine Seismology, Australia_

Dr Daryl Rebuli  
_institute of Mine Seismology, Canada_

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**Programme**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>08:00</td>
<td>Registration</td>
</tr>
<tr>
<td>08:20</td>
<td>Welcome and introduction</td>
</tr>
<tr>
<td>08:30</td>
<td>Objectives of seismic monitoring in mines</td>
</tr>
<tr>
<td>09:00</td>
<td>Seismic monitoring systems: design and requirements, seismic sensors, data acquisition units, auxiliary components, central site hardware and software, integrated passive and active seismic monitoring</td>
</tr>
<tr>
<td>09:30</td>
<td>Processing of seismic data: location (absolute, relative, 3D ray-tracing, brightness), basic and derivative source parameters, seismic source mechanisms</td>
</tr>
<tr>
<td>10:00</td>
<td>Morning break</td>
</tr>
<tr>
<td>10:30</td>
<td>Quality and integrity of seismic data: location accuracy, classification of seismic events (genuine events, blasts, ore pass noises), source parameters (effect of sensor type and bandwidth), source mechanisms and orientation settings of sensors</td>
</tr>
<tr>
<td>11:00</td>
<td>Applications: quick location of large events, re-entry protocols, quantification of seismic hazard, ground motion hazard, identification of weak structures, tracking of cave propagation, stability analysis</td>
</tr>
<tr>
<td>12:00</td>
<td>Forensic analysis of rockbursts and large seismic events: modelling of source parameters and source mechanisms, testing of sources</td>
</tr>
<tr>
<td>12:45</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:45</td>
<td>Validation of numerical stress model by seismic data: absolute and differential stresses versus location and source parameters of events, differential maps, stress orientation versus seismic source mechanisms</td>
</tr>
<tr>
<td>14:30</td>
<td>Improvement of numerical stress models: trial and error model calibration, stress inversion, adaptive adjustment of the boundary-element model</td>
</tr>
<tr>
<td>15:15</td>
<td>Afternoon break</td>
</tr>
<tr>
<td>15:45</td>
<td>Modelling and assimilation of seismicity: simulation of seismicity using Salamon–Linkov approach, incorporation of seismicity into the boundary-element model</td>
</tr>
<tr>
<td>16:30</td>
<td>Course close</td>
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</tbody>
</table>

No course proceedings will be available for purchase.

*This programme was correct at time of printing. For updates visit www.deepmining2014.com/events.*
**PROGRAMME***

### Day 1, Saturday 13 September 2014

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>08:00</td>
<td>Registration</td>
</tr>
<tr>
<td>08:30</td>
<td>Introduction</td>
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<tr>
<td>08:50</td>
<td>Rock properties</td>
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<td></td>
<td>• Intact (UCS, elastic properties, Hoek Brown and Mohr Coulomb failure criteria, laboratory and field testing methods)</td>
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<td>• Discontinuities</td>
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<td>• Rockmass classification</td>
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<tr>
<td>10:30</td>
<td>Morning break</td>
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<tr>
<td>11:00</td>
<td>Core logging and geotechnical mapping</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td>Overview of geomechanical mine design</td>
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<tr>
<td></td>
<td>• Design stages</td>
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<td>• Empirical stope design</td>
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<td>• Empirical pillar design</td>
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<tr>
<td>14:30</td>
<td>Afternoon break</td>
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<tr>
<td>15:00</td>
<td>Overview of practical approaches to numerical modelling</td>
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<tr>
<td></td>
<td>• What is numerical modelling?</td>
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<td></td>
<td>• How does it work?</td>
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<td></td>
<td>• Why do we need numerical modelling over conventional mine design techniques?</td>
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<td></td>
<td>• What are the expected outcomes of numerical analysis?</td>
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<td></td>
<td>• Limitations of numerical modelling</td>
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<tr>
<td>16:00</td>
<td>Close day one</td>
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### Day 2, Sunday 14 September 2014

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>08:30</td>
<td>Ground support</td>
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<tr>
<td></td>
<td>• Ground support principals</td>
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<td>• Support elements and functionality</td>
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<td>• Empirical design</td>
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<td></td>
<td>• Rules of thumb</td>
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<td></td>
<td>• Numerical methods</td>
</tr>
<tr>
<td>10:30</td>
<td>Morning break</td>
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<tr>
<td>11:00</td>
<td>Stope design and cablebolting</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td>Monitoring</td>
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<tr>
<td>14:00</td>
<td>Ground control QA/QC</td>
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<tr>
<td>14:30</td>
<td>Closing comments and discussion</td>
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<tr>
<td>15:00</td>
<td>Course close</td>
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</tbody>
</table>

*This programme was correct at time of printing. For updates visit www.deepmining2014.com/events.

Please note that this course is now fully subscribed. No further registrations will be accepted.

No course proceedings will be available for purchase.
The purpose of this workshop is to demonstrate how seismic data from any type of mine site can be used to help understand the rock mass response to excavation. Underground mining continues to reach for minerals deeper in the Earth and to develop more aggressive mining methods, both of which significantly contribute to higher stress levels and therefore elevated seismic activity.

Today's high accuracy seismic technology provides a database with a large magnitude range including many smaller magnitude events from which trends can be assessed to help explain the rock mass reaction from small scale fracture initiation to large fault slip.

The advanced analysis of a single event or a cluster of microseismic events has become one of the main tools incorporated into rock mechanics analysis and mining strategies. Event source mechanism stress inversion analysis and the benefits to stress model calibration will be presented and discussed.

This workshop begins with a short introduction to seismic concepts, followed by practical examples of seismic analysis methods. Attendees with laptops will be provided with a short term licence version of ESG software and an example dataset.

**Presenters**

Dr Dave Collins  
ESG Solutions, Canada

Dr Yuzo Toya  
ESG Solutions, Canada

**Programme**

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<tbody>
<tr>
<td>08:30</td>
<td>Registration</td>
</tr>
<tr>
<td>09:00</td>
<td>Introduction: welcome, brief overview of seismic terms and parameters</td>
</tr>
<tr>
<td>09:30</td>
<td>Practical considerations: seismic system types, array design, system install and requirements, system calibration</td>
</tr>
<tr>
<td>10:15</td>
<td>Morning break</td>
</tr>
<tr>
<td>10:30</td>
<td>System diagnostics: examples of use of software tools for system health analysis, trouble shooting hardware, solving common problems</td>
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<tr>
<td>11:15</td>
<td>Analysis: examples of daily and long-term use of a seismic system in relation to mine activity</td>
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<tr>
<td>12:00</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td>Advanced analysis 1: seismic event mechanism analysis, interpreting failure orientation and rock mechanics, use of seismic stress results for stress model calibration</td>
</tr>
<tr>
<td>13:45</td>
<td>Advanced analysis 2: higher accuracy event location, examples of analysis using single velocity model (VM) for rock mass and VMs that account for variable geological domains and voids, identification of unknown or seismically active geological structures and interpreting their geometry</td>
</tr>
<tr>
<td>14:30</td>
<td>Afternoon break</td>
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<tr>
<td>14:45</td>
<td>Hands-on software: training tutorial (using personal laptops*), seismic data analysis and interpretation using various ESG seismic software modules</td>
</tr>
<tr>
<td>16:30</td>
<td>Workshop close</td>
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</table>

No workshop proceedings will be available for purchase.

*This programme was correct at time of printing. For updates visit www.deepmining2014.com/events.

*Attendees must bring a modern laptop (running Windows 7/8) to participate in hands-on components of the workshop. Attendees will be provided with a short-term licence for ESG software and an example dataset for a hands-on tutorial.

**Mine Fill 2014 Proceedings**

Proceedings of the 11th International Symposium on Mining with Backfill

To purchase this, and other publications, please visit www.acg.uwa.edu.au/shop.
Safety statistics from Canada, Australia, Chile and Sweden are showing that the mining world has become very skilled at operating safely in high seismic hazard conditions. Often, the last line of defence to control seismic risk is the installation of a dynamic resistant ground support system. The performance of ground support exposed to dynamic loading has been the subject of intense research and numerous trials during the past decade. Many new products are now available on the market. There are increasingly more data and experience generated from the mines using these products. This experience and knowledge needs to be shared in a workshop environment. Furthermore, intense laboratory testing programmes on ground support have been ongoing at Canmet in Ottawa.

The focus of this workshop will be on sharing the valuable experiences gained with dynamic support. The workshop will allow for discussion periods to facilitate exchanges on some of the key topics related to dynamic resistant ground support systems.

The main objectives of the workshop are to review the most recent progress and technology development on dynamic ground support, and to offer a forum for practitioners and researchers to share their experiences and discuss relevant dynamic support issues; from the design of support systems to their performance when subjected to large seismic events.

**Facilitators**

**Winthrop Professor Yves Potvin**  
*Australian Centre for Geomechanics, Australia*

**Winthrop Professor Phil Dight**  
*Australian Centre for Geomechanics, Australia*

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<tr>
<td>08:45</td>
<td>Welcome and introduction <em>Winthrop Professor Yves Potvin, ACG, Australia</em></td>
</tr>
</tbody>
</table>
| 09:00  | Overview of dynamic testing  
Professor John Hadjigeorgiou, University of Toronto, Canada |
| 09:30  | Full scale tests of mesh in combination with dynamic rock bolts subjected to rockburst loading  
Andrea Roth, Geobrugg AG, Switzerland |
| 10:00  | Morning break                                    |
| 10:30  | A reinforcement design methodology for highly stressed rock masses  
Professor Ernesto Villaescusa, Western Australian School of Mines, Curtin University, Australia |
| 11:30  | Discussion 1  
Facilitated by Winthrop Professor Phil Dight, ACG, Australia |
| 12:00  | Lunch                                           |
| 13:00  | Estimating demand for support design in burst prone ground – could 'Newton' be misleading us?  
Professor Peter Kaiser, Laurentian University, Canada |
| 14:00  | Observed and modelled characteristics of ground motion from seismic sources  
Dr Dmitriy Malovichko, IMS, Australia |
| 14:30  | Case histories from some Canadian hard rock mines  
Brad Simser, Sudbury Integrated Nickel Operations, a Glencore Company, Canada |
| 15:00  | Afternoon break                                  |
| 15:30  | Ground support performance under dynamic loading at LaRonde Mine  
Pascal Turcotte, Agnico Eagle Mines Ltd., Canada |
| 16:00  | Ground support at LKAB’s underground mines subjected to dynamic loads  
Dr Lars Malmgren, LKAB, Sweden |
| 16:30  | Discussion 2  
Facilitated by Winthrop Professor Phil Dight, ACG, Australia |
| 17:00  | Workshop close                                   |

No workshop proceedings will be available for purchase.

*This programme was correct at time of printing. For updates visit www.deepmining2014.com/events.*
Numerical modelling is an important tool for mining geomechanics. When properly calibrated, numerical models are capable of simulating mine plans in order to predict rockmass deformation, the severity of seismicity and potential for rockbursting over the mine life. These predictions can then be used to identify potential risk for damage to critical mine infrastructure, and for ensuring personnel safety. This one day course will provide participants with the necessary tools for qualitative and quantitative model calibration so that forward simulations of mine plans can provide meaningful predictions of ground response to mining.

**Presenters**

Dr Will Bawden  
*Mine Design Engineering, Canada*

Dr Kathy Kalenchuk  
*Mine Design Engineering, Canada*

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**PROGRAMME***

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>08:00</td>
<td>Registration</td>
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<tr>
<td>08:30</td>
<td>General introduction</td>
</tr>
</tbody>
</table>
| 08:50 | Background  
  • What is numerical modelling?  
  • How does it work?  
  • Why do we need numerical modelling over conventional mine design techniques?  
  • What are the expected outcomes of numerical analysis?  
  • Limitations of numerical modelling |
| 09:10 | Numerical modelling overview  
  • Modelling applications  
  • Modelling methods (FEM, FDM, DEM, BE)  
  • Modelling options (linear versus non-linear) |
| 10:00 | Morning break |
| 10:15 | Defining material properties and constitutive models |
| 10:45 | Qualitative and quantitative approaches to model calibration  
  • Data sources (seismic data, ground movement monitoring, damage mapping and stress indicators)  
  • Back analysis to simulate observed behaviour  
  • Starting with simple model  
  • Sensitivity analysis, i.e. identify what is likely to influence the model outcomes the most  
  • What is an acceptable representation of actual behaviour? |
| 12:00 | Lunch |
| 13:00 | Interpretation of model simulations  
  • Relating rock properties to severity of damage and seismicity  
  • Expected ground response to mining  
  • Implications for ground support  
  • Sequencing and mine design |
| 15:00 | Questions and discussion |
| 15:30 | Course close |

No course proceedings will be available for purchase.

*This programme was correct at time of printing. For updates visit www.deepmining2014.com/events.*
SITE VISIT: CREIGHTON MINE, VALE CANADA LTD.
Underground Tour of Creighton Mine’s Deep Operations

19 September 2014

Creighton Mine is located 20 km west of Sudbury, and is one of the six underground mines being currently operated by Vale. The mine has been in production since 1901, and currently operates at a depth of 2,470 m and its present extraction rate is approaching 3,500 tonnes per day. As is expected from a mine in production for more than 100 years, several mining methods were used at Creighton. In the upper area, blastholes, cut-and-fill, and vertical retreat mining have been used. Today’s most economically important area of the mine is located below the 6400 level (1,950 m) and is known as Creighton Deep, where high magnitude seismic events have occurred due to the mining depth and the presence of major seismically active structures. In order to reduce the seismic risk to As Low As Reasonably Achievable (ALARA), the mine is actively using various control measures, including a unique mining method of a pillarless slot-and-slash and a top-down centre-out sequence, an identification of high seismic risk areas by using Hazard Mapping Techniques and the use of various dynamic ground support systems.

Please note that this site visit is fully subscribed and no further registrations will be accepted.

SITE VISIT: NICKEL RIM SOUTH MINE, SUDBURY INO, A GLENCORE COMPANY

19 September 2014

Sudbury Integrated Nickel Operations’ activities include Fraser Mine and Nickel Rim South Mine, Strathcona Mill and the Sudbury smelter. The company has been mining nickel-copper ores in the Sudbury area of northern Ontario, Canada, since 1929. The facilities are spread throughout the 60 km long, oval-shaped geological formation known as the Sudbury Basin. Nickel and copper are the primary metals but cobalt and precious metals, such as gold, silver, platinum and palladium are also produced. Sudbury INO currently employs more than 1,300 permanent employees.

The production rate is 1.25 Mt/ year. Featuring shaft access, its current orebodies are 1,160 to 1,710 m below surface. Nickel Rim is a primary/secondary open stoping operation.

Please note that spaces are limited to 18 people only.

For further site visit information, itineraries and booking forms, please visit www.deepmining2014.com/events.
REGISTRATION FORM

CONTACT DETAILS Please print. * denotes mandatory fields.

*Title (Mr, Mrs, Miss, Ms, Dr, Prof., Other) ____________________________________________

*Family Name ____________________________________________________________

*First Name ________________________________________________________________

Preferred Name __________________________________________________________

*Position ________________________________________________________________

*Organisation ____________________________________________________________

*Mine/Dept ________________________________________________________________

*Address ________________________________________________________________

________________________________________________________________________

Phone ________________________________________________________________

Fax ________________________________________________________________

Mobile ________________________________________________________________

*Email ________________________________________________________________

All attendees will have their name, affiliation, address, telephone, fax and email address printed in
the delegate list and will receive event proceedings, luncheons and refreshments.

☐ Do not include my details in the event delegate list.

☐ If you require an invitation letter for Visa purposes, please contact the ACG.

For more information regarding Canadian Visas, please visit: http://www.cic.gc.ca/english/visit/visas.asp.

PAYMENT DETAILS

Payment to accompany registration. All bank fees are the responsibility of the registrant.

Prices include Canadian taxes.

ABN 37 882 817 280

Total payment CAD ______________________________

EFT (preferred)

Westpac Banking Corporation, University Campus, Hackett Drive, Crawley WA 6009

Account name: The University of Western Australia

Account: 328823

BSB: 036054

IBAN: 036054328823

SWIFT Code: WPACAU25

Deposit reference: DHS first initial and family name (e.g. DHS J Smith)

Please forward remittance advice to the ACG.

Please note any special dietary requirements here: ________________________________________________________________

DELEGATE CANCELLATIONS

Up to 8 days before event commencement: an administration fee of CAD150/AUD147 will
be charged. 7 or less days before: no refund. Non-attendance: no refund. Substitutions will
be accepted at any time. The ACG reserves the right to cancel events if fewer than
16 registrations are received.


^ Students are required to provide proof of full-time enrolment.

Deep Mining 2014 Conference speakers please do not fill out this form, you
will be sent a speaker registration form.

Seventh International Conference on Deep and High Stress Mining (1410)
16–18 September 2014

Individual day rates are available. Please contact the ACG for more details.

Applications of Seismic Monitoring in Mines Course (1416)
13 September 2014

Practical Rock Mechanics in Underground Mines Course (1405)
13–14 September 2014

Getting the Most from a Seismic System Workshop (1417)
14 September 2014

Ground Support Subjected to Dynamic Loading Workshop (1408)
15 September 2014

Practical Calibration of Numerical Models for Meaningful Predictions
of Ground Behaviour Course (1411) | 19 September 2014

Deep Mining 2014 Conference Dinner
17 September 2014

Site Visit: Nickel Rim South Mine, Sudbury INCO,
A Glencore Company | 19 September 2014

Site Visit: Creighton Mine, Vale Canada Ltd. | 19 September 2014

Please note any special dietary requirements here: