Ninth International Symposium on Ground Support in Mining and Underground Construction

23–25 October 2019 | The Radisson Hotel, Sudbury, Canada

EARLYBIRD REGISTRATION ENDS 13 SEPTEMBER 2019!

Following on from previous symposia, the Australian Centre for Geomechanics looks forward to hosting Ground Support 2019 in Canada. The International Ground Support Symposia have been a fundamental platform for advancing ground support excellence in mining and underground construction for over 35 years. It has been more than 25 years since this symposium was held in Canada and we are delighted to return to Sudbury!

Symposium Themes
- Ground support monitoring
- Ground support in challenging conditions
- Dynamic testing of ground support
- Case studies and mechanised installation
- Numerical modelling
- Ground support corrosion
- Ground support design considerations
- New ground support products
- QA/QC and management plan

Previous Ground Support Symposia
1st 1983 Abisko, Sweden
2nd 1992 Sudbury, Canada
3rd 1997 Lillehammer, Norway
4th 1999 Kalgoorlie, Australia
5th 2004 Perth, Australia
6th 2008 Cape Town, South Africa
7th 2013 Perth, Australia
8th 2016 Luleå, Sweden

Keynote speakers:
- Peter Andrews
  VP and Group Head of Geotechnical, Gold Fields Australia Pty Ltd, Australia
  Ground support selection rationale: a Gold Fields’ perspective

- Dr Mark Board
  Vice President – Technical Services, Hecla Limited, USA
  Ground support from a corporate perspective

- Frédéric Mercier-Langevin
  General Manager Goldex Complex, Agnico Eagle Mines Ltd., Canada
  Ground support – a mine manager’s perspective

www.groundsupport2019.com
Workshop Overview

Ground support is one of the main control measures to mitigate the risk of rockfalls and rockbursts in underground mines. Designers must ensure the capacity of the support system will exceed the demand due to the dead weight of rockmass damage and loosening, as well as the dynamic stress waves induced by seismic events.

There are many challenges in assessing the capacity of ground support systems. For example, as soon as the ground support is installed, a degradation process begins. The capacity of the support system is gradually consumed due to, amongst other factors, ground deformation, corrosion, and repeated dynamic loading from seismic events. It is the responsibility of the mine operators to rehabilitate ground support when the capacity no longer meets the demand specified in the design criteria. Hence, it is extremely important to monitor the performance of ground support systems over time.

In recent years, new and promising technologies, including lidars, drones, data acquisition and underground WiFi, can be packaged to enable a better understanding of the ground support capacity degradation. Some of them have shown promising results, but they still have limitations.

Workshop Objective and Format

This workshop will explore the current status of different emerging technologies and how they can be applied to monitor the performance of ground support. The programme is divided into two themes: the morning session will examine the technologies focussing on convergence measurements from repeated laser surveys. The afternoon session is dedicated to instrumentation of reinforcement and surface support.

For each theme, the format will involve a series of presentations from technology suppliers/developers, followed by an open discussion lead by a panel of experts carefully selected based on their extensive experience and knowledge on applying these technologies.

Workshop Facilitators

**Professor John Hadjigeorgiou**
Pierre Lassonde Chair in Mining Engineering University of Toronto, Canada

**Professor Yves Potvin**
Professor of Mining Geomechanics Australian Centre for Geomechanics, Australia

Workshop Preliminary Programme*

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>07:30</td>
<td>Registration</td>
</tr>
<tr>
<td>08:15</td>
<td>Welcome and introduction <strong>Professor Yves Potvin</strong>, Australian Centre for Geomechanics, Australia</td>
</tr>
<tr>
<td>08:30</td>
<td><strong>THEME 1: Convergence measurements from repeated laser surveys</strong></td>
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<tr>
<td>08:45</td>
<td>Facilitator: <strong>Professor Yves Potvin</strong></td>
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<tr>
<td>09:00</td>
<td><strong>Use of aerial and ground drones to assess ground movements in underground mines</strong></td>
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<tr>
<td>09:30</td>
<td>Dr Syed Naeem, Clickmox Solutions Inc.</td>
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<tr>
<td>10:00</td>
<td><strong>Mobile LiDAR solution for underground convergence monitoring and assessment: a case study</strong></td>
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<tr>
<td>10:30</td>
<td>Curtis Watson, Pecktech</td>
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<tr>
<td>11:00</td>
<td><strong>Managing the deformation of ground support and reinforcement</strong></td>
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<tr>
<td>11:30</td>
<td>Matt MacKinnon, Unnamed Aerial Services Inc.</td>
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<tr>
<td>11:45</td>
<td><strong>Morning break</strong></td>
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<tr>
<td>12:00</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td><strong>THEME 2: Instrumentation of reinforcement and surface support</strong></td>
</tr>
<tr>
<td>13:15</td>
<td>Facilitator: <strong>Professor John Hadjigeorgiou</strong>, University of Toronto</td>
</tr>
<tr>
<td>13:30</td>
<td><strong>A contribution through instrumentation to a better understanding of rockmass behaviour and ground support performance in a high stress mine enviroment</strong></td>
</tr>
<tr>
<td>13:45</td>
<td>Dr Syed Naeem, Clickmox Solutions Inc.</td>
</tr>
<tr>
<td>14:00</td>
<td><strong>A conceptual framework for unlocking of value from instrumentation data</strong></td>
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<tr>
<td>14:15</td>
<td>Dr Andrew Hyett, YieldPoint Inc.</td>
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<tr>
<td>14:30</td>
<td><strong>The application of instrumentation</strong></td>
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<tr>
<td>14:45</td>
<td>Peter Lausch, Mine Design Technologies Inc.</td>
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<tr>
<td>15:00</td>
<td><strong>Afternoon break</strong></td>
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<tr>
<td>15:15</td>
<td><strong>Panel discussion Professor Bruce Hebblewhite, Professor Mining Engineering, UNSW Sydney, Australia</strong></td>
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<tr>
<td>15:30</td>
<td>Dr Brad Simser, Principal Ground Control Engineer, Glencore; Dr Mike Yao, North Atlantic Technical Services, Vale Canada Ltd.</td>
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<tr>
<td>16:00</td>
<td>**Workshop wrap-up **<strong>Professor Yves Potvin</strong></td>
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<tr>
<td>16:45</td>
<td><strong>Workshop close</strong></td>
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</table>

*Programme is subject to change.*

**Monitoring Performance of Ground Support Workshop**

22 October 2019 | Ballroom, The Radisson Hotel | Sudbury, Canada

**www.groundsupport2019.com**
DAY ONE – PRELIMINARY PROGRAMME*
WEDNESDAY 23 OCTOBER 2019

07:00 REGISTRATION

07:45 Welcome and introduction  J Hadjigeorgiou, University of Toronto, Canada

08:00 KEYNOTE ADDRESS: Ground support from a corporate perspective  M Board, Hecla Limited, USA

SESSION ONE: GROUND SUPPORT MONITORING (1)

08:30 Laser-based scanning to manage geotechnical risk in deep mines  DB Counter, Glencore Canada Corp., Canada

09:00 Advanced geotechnical monitoring technology to assess ground support effectiveness  LP Gélinas, V Falmagne, B Bédard, Agnico Eagle Canada Inc., Canada; O Matte, Université Laval, Canada

09:30 A new paradigm in ground support monitoring through ultrasonic monitoring of clusters of rockbolts  Z Sun, KT Wu, SE Kruger, D Levesque, D Gagnon, Y Quenneville, National Research Council Canada, Canada; R Lacroix, R Royer, Natural Resources Canada

10:00 MORNING BREAK

SESSION TWO: GROUND SUPPORT IN CHALLENGING CONDITIONS

10:30 Response of a support system to seismic events: case study Mina Uchucchacua, Peru  CV Gonzalez, MIRARCO Mining Innovation, Laurentian University, Canada; R Beltran, Compañía de Minas Buenaventura S.A.A., Peru; J Henning, BBA, Canada

11:00 Ground support challenges in arctic mining conditions  V Falmagne, N St-Onge, Agnico Eagle Mines Ltd., Canada

11:30 Assessing the contribution of seismicity to the demand on ground support elements at LaRonde mine  G Sasseville, M Grenon, Université Laval, Canada; P Morissette, Agnico Eagle Mines Ltd, Canada

12:00 LUNCH

SESSION THREE: DYNAMIC TESTING OF GROUND SUPPORT

13:00 Development of a new Sandvik Little Brother dynamic rock bolt and the in situ dynamic evaluation of bolts  W Roach, M Rataj, B Darlington, Sandvik Mining and Rock Technology, Australia

13:30 About the likely performance of ground support systems submitted to dynamic loading  D Gaudreau, Newmont Goldcorp, Australia

14:00 Dynamic testing: determining the residual dynamic capacity of an axially strained tendon  G Knox, New Concept Mining, South Africa; A Berghorst, New Concept Mining, USA

14:30 Dynamic testing of a surface support system  R Brändle, Geobrugg AG, Switzerland; RL Fonseca, Geobrugg Ibérica S.A., Spain

15:00 AFTERNOON BREAK

SESSION FOUR: CASE STUDIES AND MECHANISED INSTALLATION

15:30 Failure mechanisms and ground support observations at Coleman mine, Sudbury Basin  D Landry, E Reimer, Vale Canada Ltd, Canada

15:45 The evolution and performance of the Henderson Mine’s C-arch shotcrete drawpoint support  NA Shea, Climax Molybdenum, USA

16:00 High-tensile steel rolled mesh applications for ground support  C Pritchard, Pritchard Mining Technologies Inc., USA; E Rorem, Geobrugg North America; USA

16:15 A review of mining practices for surface support: an international survey  H Schunnesson, G Shekhar, A Gustafson, D Johansson, Luleå University of Technology, Sweden

16:30 Mining initiative on ground support and equipment: 12 years of accomplishments  G Swan, Rock Mechanics & Mine Design, Canada; J Hedlin, Rock Tech Centre, Sweden

16:45 Question time

17:00 Major Sponsor presentation Sika

17:05 DAY ONE CLOSE

Host City

Our host city of Sudbury is located in Ontario, Canada and was founded following the discovery of nickel ore in 1883. It is the largest city in Northern Ontario and is surrounded by lakes and hills which allow for a variety of outdoor activities. It is an apt location for Ground Support 2019 with mining and related industries playing a big part in the city and surrounding areas.

*Preliminary programme is subject to change. For updates, please visit www.groundsupport2019.com

www.groundsupport2019.com
### DAY TWO – PRELIMINARY PROGRAMME*  
**THURSDAY 24 OCTOBER 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Details</th>
</tr>
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<tr>
<td>08:00</td>
<td>KEYNOTE ADDRESS</td>
<td>Ground support selection rationale: a Gold Fields’ perspective P Andrews, Gold Fields Australia Pty Ltd, Australia</td>
</tr>
<tr>
<td>08:30</td>
<td>SESSION FIVE: NUMERICAL MODELLING (1)</td>
<td>Stability assessment of initial shotcrete lining using two-dimensional continuum numerical modelling S Naseri, N Bahrami, Dalhousie University, Canada</td>
</tr>
<tr>
<td>09:00</td>
<td></td>
<td>Explicit discrete fracture network numerical analyses of the stability of underground stopes and effects of cablebolt support at Mine Raglan T Lavoie, P Andrieux, S Guido, Andrieux and Associates Geomechanics Consulting, Canada; R Caumartin, Glencore, Mine Raglan, Canada</td>
</tr>
<tr>
<td>09:30</td>
<td></td>
<td>Evaluation of ground support design at Eleonore Mine using bonded block modelling T Garza-Cruz, L Bouzeran, Itasca Consulting Group Inc., USA; M Pierce, Pierce Engineering, USA; A Jalbout, M Ruest, Goldcorp, Canada</td>
</tr>
<tr>
<td>10:00</td>
<td>MORNING BREAK</td>
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<tr>
<td>10:30</td>
<td>SESSION SIX: GROUND SUPPORT MONITORING (2)</td>
<td>Development of a single-pass detailed damage mapping application D Cumming-Potvin, Y Potvin, J Wesseloo, P Harris, C Ho, M Heinsen Egan, Australian Centre for Geomechanics and The University of Western Australia, Australia</td>
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<tr>
<td>11:00</td>
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<td>Relating measured rock mass deformation to support load D Milne, University of Saskatchewan, Canada</td>
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<td>11:30</td>
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<td>Technologies of ground support monitoring in block caving operations T Dawn, Canary Systems, USA</td>
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<tr>
<td>12:00</td>
<td>LUNCH</td>
<td></td>
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<tr>
<td>13:00</td>
<td>SESSION SEVEN: GROUND SUPPORT CORROSION</td>
<td>Corroded rock support issues: implementation of an investigation and rehabilitation program JF Dorion, Raglan Mine, Canada</td>
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<tr>
<td>13:30</td>
<td></td>
<td>Analysis of in situ and laboratory corrosion coupons AJ Chambers, CB Sunderman, CC Clark, MJ Powers, National Institute for Occupational Safety and Health, USA</td>
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<tr>
<td>14:00</td>
<td></td>
<td>Rusty bolts: planning for corrosion of ground support in underground mines RP Preston, JM Roy, RP Bewick, Golder Associates Ltd., Canada</td>
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<tr>
<td>14:30</td>
<td></td>
<td>Microbiologically induced cable bolt corrosion in underground coal mines H Chen, O Kimyon, HL Ramandi, B Hebblewhite, A Crosky, S Saydam, UNSW Sydney, Australia; AH Kaksonen, C Morris, CSIRO Land and Water, Australia</td>
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<td>15:00</td>
<td>AFTERNOON BREAK</td>
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<tr>
<td>15:30</td>
<td>SESSION EIGHT: GROUND SUPPORT DESIGN CONSIDERATIONS</td>
<td>Limitations of standard analytical methods of shaft liner design N-A Hentrich, DMT GmbH &amp; Co. KG, Germany; DS Calderon, DMT Geosciences Ltd., Canada; S Bock, J Franz, DMT GmbH &amp; Co. KG, Germany</td>
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<tr>
<td>15:45</td>
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<td>Application of the Geological Strength Index in Peruvian underground mines: retrospective 18 years after its implementation LAM Camones, Mine Design Engineering Inc., Canada; CC Nuñez, Pan American Silver Peru, Peru</td>
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<tr>
<td>16:00</td>
<td></td>
<td>Suppression of tunnel spalling by engineered rock mass damage AC McDonald, SD McKinnon, Queen’s University, Canada</td>
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<tr>
<td>16:15</td>
<td></td>
<td>A case study on the creation and application of a geotechnical block model D Sewnun, W Joughin, M Wanless, P Mpunzi, SRK Consulting, South Africa</td>
</tr>
<tr>
<td>16:30</td>
<td></td>
<td>Towards optimising ground support systems in underground mines Y Potvin, Australian Centre for Geomechanics and The University of Western Australia, Australia; J Hadjigeorgiou, University of Toronto, Canada; J Wesseloo, Australian Centre for Geomechanics and The University of Western Australia, Australia</td>
</tr>
<tr>
<td>16:45</td>
<td></td>
<td>Question time</td>
</tr>
<tr>
<td>17:00</td>
<td>DAY TWO CLOSE</td>
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</table>

### Symposium Dinner

The Ground Support 2019 Symposium dinner will be held on the night of Thursday 24 October 2019 at Science North. It is an opportunity for delegates, sponsors and speakers to network and enjoy the company of their fellow attendees in a relaxed environment away from the symposium and enjoy the hospitality that Sudbury has to offer.

*Preliminary programme is subject to change. For updates, please visit www.groundsupport2019.com*
The repository aims to provide the mining geomechanics fraternity with open access to peer-reviewed conference proceedings across the geotechnical mining spectrum that may assist readers to maintain and develop their skills, knowledge and capabilities. The papers from the Ninth International Symposium on Ground Support in Mining and Underground Construction will be openly accessible on the online repository as of Monday 14 October 2019. Visit https://papers.acg.uwa.edu.au

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SPONSORSHIP

Ground Support 2019 Sponsorship Opportunities

Sponsor and exhibitor opportunities are available for the Ninth International Symposium on Ground Support in Mining and Underground Construction. The symposium is an excellent platform to enhance your presence in the market and position your organisation as one of the leaders in the industry. ACG sponsors and exhibitors enjoy numerous benefits, including:

- Direct access and exposure to a niche target audience
- Increased brand awareness
- Achieving a high profile association with an innovative and credible industry event

Major Sponsors

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![GEOBRUGG](geobrugge.png)

![ITASCA](itasca.png)

![New Concept Mining](new-concept-mining.png)

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View the sponsorship packages at [www.groundsupport2019.com/sponsorship/](http://www.groundsupport2019.com/sponsorship/)
REGISTRATION FORM

IMPORTANT NOTE
Ground Support 2019 Symposium speakers please do not fill out this form. Speakers will be contacted by the ACG upon acceptance of their paper and will be sent a speaker registration form. The speaker registration fee for the Ground Support 2019 Symposium is AUD650/CAD680.

CONTACT DETAILS
Please print. * denotes mandatory fields.

*Title (Mr, Mrs, Miss, Ms, Dr, Prof., Other) ____________________________
*Family Name __________________________________________
*First Name _____________________________________________
Preferred Name ___________________________________________
*Position _________________________________________________
*Organisation _____________________________________________
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>All confirmations/event updates will be sent via email.

Registrant contact details shall be published in the events authorised attendee list made available to event attendees, sponsors and exhibitors, who may contact you, including electronically, in the promotion of their products and services.

☐ I give permission for my details to be included in the Ground Support 2019 and associated events attendee lists.

☐ I give permission for the ACG to forward me ACG research, training and/or education information advice, including electronic communications.

☐ I require an invitation letter for visa purposes (please forward a copy of your passport information page). For more information regarding Canadian visas, please visit https://www.canada.ca/en/services/immigration-citizenship

Delegate Terms and Conditions are available at acg.uwa.edu.au/disclaimer

PAYMENT
Total payment AUD/CAD
Payment to be received by 12 October 2019. All bank fees are the responsibility of the registrant. All prices include applicable taxes.
ABN 37 882 817 280

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☐ Electronic Funds Transfer (EFT): Please return this completed form to info-acg@uwa.edu.au and the ACG will send you an invoice with EFT details included.
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Ninth International Symposium on Ground Support in Mining and Underground Construction (1925) | 23–25 October 2019

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† Please visit www.acg.uwa.edu.au/corp_affiliates to view the list of ACG Corporate Affiliates.
^ Students are required to provide proof of full-time enrolment.

Ground Support 2019 Symposium Dinner*
24 October 2019
* Limited to symposium attendees and partners only.

Please notify us below of any special dietary requirements.
Diet ________________________________________________________________

All full registrations will receive luncheons and refreshments. Symposium papers will be accessible at papers.acg.uwa.edu.au from 21 October 2019. If you would like a printed copy of the proceedings, please tick the box below.

Ground Support 2019 Proceedings
Softbound, full colour book
* Limited to symposium attendees only.

AUD/CAD

Monitoring Performance of Ground Support Workshop (1923)
22 October 2019

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DELEGATE CANCELLATIONS
Up to 8 days before event commencement: an administration fee of AUD150/CAD155 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 the symposium and associated events if insufficient registrations are received.

ACG Affiliate
† Please visit www.acg.uwa.edu.au/corp_affiliates to view the list of ACG Corporate Affiliates.
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