30th Mine Seismology Seminar

25 – 27 June 2020, Marriott Denver West, Colorado

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<th>Date</th>
<th>Event</th>
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<tr>
<td>Thursday 25 June</td>
<td>Meeting of the International Research Advisory Board of the Institute of Mine Seismology</td>
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<tr>
<td>10h00 - 16h00</td>
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<tr>
<td>Thursday 25 June</td>
<td>Short Course: Mine Seismology Primer, i.e. Seismology for Mining Consultants</td>
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<td>09h00 - 16h00</td>
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<td>Thursday 25 June</td>
<td>Rocks Change Like the Weather and Heal Like Living Bodies, lecture by Prof. Roelof Snieder, Director of Center for Wave Phenomena, Colorado School of Mines.</td>
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<td>16h30 - 17h15</td>
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<tr>
<td>Thursday 25 June</td>
<td>Ice-Breaker hosted by the Institute of Mine Seismology</td>
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<td>Friday 26 June</td>
<td>Presentations on Monitoring the Seismic Rock Mass Response to Mining - Day 1</td>
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<tr>
<td>09h00 - 18h00</td>
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<tr>
<td>Friday 26 June</td>
<td>Dinner hosted by the Institute of Mine Seismology</td>
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<td>19h00</td>
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<tr>
<td>Saturday 27 June</td>
<td>Presentations on Numerical Modelling for Seismically Active Mines - Day 2</td>
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Training Courses, Marriott Denver West, Colorado

- **25 June, 09h00-16h00**  **Seismology Primer**, Dr Daryl Rebuli & Dr Gerrit Olivier

For more information on registration, accommodation and social programme please contact Megan.Thompson@IMSeismology.org
Objectives of the Seminar

Considerable progress has been made in the quantification of seismic sources and in the quantification of seismicity. Most modern seismic systems and associated seismological software are capable to locate seismic events, including ray tracing, and to quantify seismic sources by seismic potency or moment and their tensors, radiated seismic energy and other derivatives. Seismicity is routinely characterised by its size and time distributions, including spatial and temporal clustering and migration, and by parameters reflecting changes in the strain and stress regime and the rheological properties of the rock mass deformation associated with the seismic radiation. Although seismic waveforms do not provide direct information about the absolute stresses and strains, they do provide useful information about stress orientation and about the spatial and temporal strain and stress changes. However, all these capabilities are not always translated into practical instruments to manage seismic hazard in mines.

We will discuss the latest progress in passive seismic monitoring, including seismic sensors capable of recording the strong ground motion. We will also review methodologies to assess the long, intermediate and short term seismic hazard, including the re-entry protocol and seismic TARPs. It will include data selection, the issue of “the maximum magnitude event”, the power law size distribution and its intricacies, the GMPE - Ground Motion Prediction Equation, distribution of distances and mapping the ground motion hazard in space.

Most applications of modelling with seismic data to date are limited to qualitative correlation between location and mechanisms of events with the modelled stresses. We will report encouraging results on the quantitative correlation that makes it possible to improve numerical modelling. We will also discuss methodology of modelling the influence of hydraulic fracturing on stress redistribution.

Over the last few years we've made considerable progress in the quantification of rock mass properties and monitoring their changes in space and time. Recent advances in active seismic monitoring, seismic interferometry and ambient noise analysis achieve a resolution at least 100 times better than classical seismic velocity inversion. This is useful to monitor the real-time stress changes in 3D due to mining, as well as quantification of pillar strength and more accurate cave front tracking in block cave mines. These advances have also enabled us to directly image and monitor areas affected by mining activities where classical seismology has not been very effective, such as tailings dams, old mine workings and natural caves.

The main themes of the Seminar are:

1. Seismic Sensing and Monitoring Technologies.

I'm asking all presenters to tell us: (1) why you did this work, (2) how you did it, (3) what you found, (4) what you think it means, and (5) what are the limitations.

Looking forward to see you in Golden in June 2020
Aleksander J. Mendecki
Chairman and Head of Research
Institute of Mine Seismology
From Common to Best Practice in Underground Rock Engineering  
Dr Peter K. Kaiser, Professor Emeritus, Laurentian University, Canada.

Mining Deeper: The Need for New Numerical Tools for Brittle Rock Failure  
Prof. Erik Eberhardt, The University of British Columbia, Canada.

Short Term Adjustments to Achieve Long Term Plans: Managing Seismically Active Mines  
Matthew Sullivan, Freeport, PFTI, Indonesia.

Fault Slip Focal Mechanisms Do Not Have to Mean Pre-existing Faults  
Dr Rob Bewick, Golder Associates, Canada.

Moment Tensor Inversion From In-mine and Regional Data: Comparison  
Prof. Savka Dineva, Luleå University of Technology.

Seismic Events “Caused” by Orepasses in Kiirunavaara Mine  
Mirjana Boskovic and Christina Dahné Lindqvist, LKAB, Sweden.

Chain of Events Surrounding the Cave Through of Printzskold Crown Pillar  
Kristina Jonsson, LKAB, Sweden.

Next Record Breaking Magnitude for Injection Induced Seismicity  
Dr Zuzana Jechumtálová, Seismik, Czech Republic.

Interpretation of Damaging Seismic Event in Kittilä Mine  
Antti Pyy, Kittilä Mine, Agnico Eagle Finland Oy, Finland.

Location Error Based Seismic Cluster and its Application to Burst Damage Assessment in Underground Coal Mines  
Prof. Ismet Canbulat, University of New South Wales, Australia.

Proactive Measures to Evaluate Geotechnical Risk in Development for Deep Mining: Onaping Depth Project Case Study  
Tony Buttler, ESG Solutions, Canada

Seismic Data Processing Using Convolutional Neural Networks and Probabilistic Graphical Models  
Dr Cornel du Toit and Mark Green, Institute of Mine Seismology, South Africa.

Recent Advances in Seismic Sensing and Monitoring Technologies  
Gareth Goldswain, PhD Candidate, Institute of Mine Seismology, Australia.

Using Unsupervised Machine Learning to Investigate Large Datasets of Mining Induced Seismicity  
Stephen Meyer, PhD Candidate, Institute of Mine Seismology, Australia.

Forensic Analysis of Damaging Seismic Events in Mines  
Dr Dmitriy Malovichko, Institute of Mine Seismology, Australia.

Calibration of Numerical Stress Models Using Seismic Monitoring Data
Dr Dmitriy Malovichko, Institute of Mine Seismology, Australia.

Passive Seismic Tomography for Rock Mass Characterization and Mine Planning
Dr Phil Dales, Institute of Mine Seismology, Canada.

Continuous Monitoring of Underground and Open Pit Mines with Seismic Noise Interferometry
Dr Gerrit Olivier, Institute of Mine Seismology, Australia.

High Resolution Seismic Imaging with Dense Nodal Arrays Near Active Mines
Dr Gerrit Olivier, Institute of Mine Seismology, Australia.

Routine Numerical Modelling for Seismically Active Mines
Gys Basson, PhD Candidate, Institute of Mine Seismology, Australia.

Assessing Ground Motions from Large, Complex Events using Kinematic Modelling
Dr Ernest Lötter, Institute of Mine Seismology, Australia.

Ground Motion Hazard: Utility of the Cumulative Absolute Displacement
Dr Aleksander J. Mendecki, Institute of Mine Seismology, Australia.