## Programme* Day One

**Welcome and opening address** PM Dight, Australian Centre for Geomechanics, The University of Western Australia, Australia

### Keynote Addresses

**Keynote: BHP Mine Water Management: Integrated Approach to Manage Risk and Optimise Resource Value**

C Abumanda Calderon, BHP, Australia

**Keynote: Slope Performance Monitoring: System Design, Implementation and Quality Assurance**

R Sharon, Sharon Geotechnical LLC, USA

**Keynote: Geomechanics of Australian Open Cut Coal Mining**

JV Simmons, Sherwood Geotechnical and Research Services, and The University of Newcastle, Australia

### Safety and Risk Management (1)

**Practical Waste Rock Dump and Stockpile Management in High Rainfall and Seismic Regions of Papua New Guinea**

N Bar, Geckos Geotechnics Pty Ltd, Australia; J Semi, M Koek, Ok Tedi Mining Limited, Papua New Guinea; G Owusu-Bempah, A Day, Harmony Gold Mining Company Limited, Papua New Guinea; S Nicoll, J Bu, Newcrest Mining Limited, Papua New Guinea

**New Techniques for Characterising Damage in Rock Slopes: Implications for Engineered Slopes and Open Pit Mines**

D Donati, D Stead, Simon Fraser University, Canada; D Elmo, University of British Columbia, Canada; E Onsel, Simon Fraser University, Canada

**Economic Consequences of Geotechnical Instabilities in Open Cut Coal Mines**

K Young, A Robotham, G Virk, BHP, Australia

**Regulation of Open Pit Slope Stability in Russia**

A Makarov, I Livinsky, V Spirin, SRK Consulting (Russia) Limited, Russia; A Pavlovich, Saint-Petersburg Mining University, Russia

**An Overview of the Slope Monitoring Program at the Serra Sul Iron Ore Project, S11D, Northern Brazil**

MF Souza, E Friguetto, WI Souza, AHCIR Castro, Vale S.A., Brazil

**Trigger Action Response Plan Development and Optimisation at the Bingham Canyon Mine**

K Bakken, GK Chapin, MG Abrahams, Rio Tinto Kennecott Copper, USA

**Management of Geotechnical Hazards Through Embracing Technology and Innovative Thinking**

KT Mandisdazo, Evolution Mining Ltd, Australia

**InSAR Investigation of Sackung-like Features and Debris Flows in the Vicinity of Hawsbury Island and Hartley Bay, British Columbia, Canada**

D Huntley, D Rotheram, P Bobrowsky, G Lintern, R MacLeod, C Brillon, Geological Survey of Canada, Canada

**Use of Laser Scanner Technology as Part of the Slope Stability Risk Management Strategy at Letšeng Diamond Mine**

N Lefa, Letšeng Diamonds (Pty) Ltd, Lesotho; V Nkene, Maptek, South Africa

**Managing Ice Walls and Other Operational Challenges While Optimising Victor Mine Late Stage Opportunities**

M Rougier, Golder, Canada; PJH de Graaf, Anglo American, De Beers Group of Companies, Australia; M Desjardins, De Beers Canada Inc., Canada; M O’Leary, Mount Polley, Canada (formerly De Beers, Canada); N Yugo, Independent Consultant, Canada (formerly De Beers Canada Inc., Canada); B Kilbride, De Beers Canada Inc., Canada

**Evolution and Management of Large-scale Instability: a Case Study from Ok Tedi**

G Kennedy, D Casagrande, PSM, Australia

**InSAR in the Clouds: Satellite-based Monitoring at Grasberg Mine**

IN Leighton, 3V Geomatics Inc., Canada; M Sullivan, Freeport McMoRan, Indonesia

**Brumadinho Dam InSAR Study: Analysis of TerraSAR-X, COSMO-SkyMed and Sentinel-1 Images Preceding the Collapse**

D Holder, S Donegan, A Poon, 3V Geomatics Inc., Canada

**Post-Shearing Data Collection with Enhanced Network Smart Markers**

J Beinergger, R Yost, Teck Resources Limited, Canada; S Steffen, D Whiteman, Elexon Mining, Australia; AM Thomas, M Royle, SRK Consulting (Canada) Inc., Canada; E Widzykapehart, University of Chile, Chile

**Risk Management and Alarming Based on a New Sensitivity Correction Algorithm for Ground-based Radars**

A Cabrejo, P Bellett, G Stickley, GroundProbe Pty Ltd, Australia; R Silva, Y Gunaris, J Pérez, Compañía Minera Doña Inés de Collahuasi, Chile

**The Use of Strain Threshold in Slope Stability Trigger Action Response Plans**

S Coetsee, Reutech Mining, South Africa; R Armstrong, P Terbrugge, SRK Consulting (South Africa) (Pty) Ltd, South Africa

**Influence of the Hydrothermal Alteration Rocks on the Stability of an Open Pit Mine of the South of Peru: a Case Study**

S Castro, C Huaman, Anddes, Peru

### Processing of Geotechnical Data and Limit Design

**Evolution of a Geotechnical Model for Slope Design in an Active Volcanic Environment**

PM Wein, MJ Fowler, TD Sullivan, M Kobler, PSM, Australia; J Bu, Newcrest Mining Limited, Papua New Guinea

**Geotechnical Evaluation of the East Wall of the Cerro Corona Pit**

J Dueñas, G Becerra, R Ordoñez, Gold Fields, Peru; PG Andrews, Gold Fields Australia Pty Ltd, Australia

**Introducing G.RE.T.A. – An Innovative Geo-resistivimeter for Long-term Monitoring of Earthen Dams and Unstable Slopes**

G Treoldi, Politecnico di Milano, Italy; A Hojat, Shahid Bahonar University of Kerman, Iran and Politecnico di Milano, Italy; L Zanzi, Politecnico di Milano, Italy; A Certo, LSI Lastem s.r.l., Italy
SAFETY AND RISK MANAGEMENT (2)

BHP Western Australia Iron Ore geotechnical open cut slope design system: a simple pragmatic process for slope risk decisions A Haile, D Ross, A Maldonado, M Neyaz, C Rajbhandari, BHP, Australia

Characterisation of a rock slope showing three weather-dominated failure modes M Roustaei, R Macciotta, M Hendry, J Rodriguez, University of Alberta, Canada; C Gräpel, Klohn Crippen Berger, Canada; R Skirrow, Alberta Transportation, Canada

Monitoring and managing large deformation pit slope instabilities at a British Columbia copper mine C Dick, BGC Engineering Inc., Canada; S Nunoo, S Smith, Gibraltar Mines Ltd., Canada; W Newcomen, D Kinakin, J Stilwell, J Danielson, BGC Engineering Inc., Canada

ASSESSMENT AND IMPLICATIONS FOR UNCERTAINTY IN DESIGN

3D limit equilibrium method for rock slope stability analysis using generalised anisotropic material model NS Kumar, Universiti Sains Malaysia, Malaysia & Centre of Excellence for Engineering and Technology JKR, Malaysia; MAM Ismail, Universiti Sains Malaysia, Malaysia. Presented by SK Nagendran, Universiti Sains Malaysia, Malaysia

An overview of bench design for cut slopes with an example of an advanced dataset assessment technique S Coetsee, Reutech Mining, South Africa

Toe rock mass strength in footwall failures A Duran, PSM, Australia; D Cardona Lopez, Prodeco, Colombia

Increasing the reliability of mining plans by predicting geotechnical instabilities with structural control: case study at a BHP mine, northern Chile C Roa, J Calderón, Minera Escondida, Chile; R Castellón, M Vargas, TlMining, Chile

Tuff bands and the stability of coal mine slopes K Koosman, PSM, Australia

PROCESSING OF GEOTECHNICAL DATA AND LIMIT DESIGN (2)

Capturing/interpreting non-obvious slope controlling structures J Mathis, Zostrich Geotechnical, USA

Post-blast slope stability monitoring with slope stability radar P Saunders, GroundProbe Pty Ltd, Australia; JM Kabuya, ArcelorMittal Mining Canada, Canada; A Torres, Hillgrove Resources Ltd, Argentina; R Simon, École Polytechnique de Montréal, Canada

Combining structural data with monitoring data in open pit mines to interpret the failure mechanism and calibrate radar alarms P Farina, F Bardi, Geoapp s.r.l., Italy; L Lombardi, G Gigli, Università degli Studi di Firenze, Italy

The shear strength of bedding partings in shales of the Pilbara: the similarity of non-dilatational angles, mineralogy relationships, and nominal roughness A Maldonado, The University of Western Australia, Australia; PM Dight, Australian Centre for Geomechanics, The University of Western Australia, Australia

Disrupting rock engineering concepts: is there such a thing as a rock mass digital twin and are machines capable of learning rock mechanics? D Elmo, University of British Columbia, Canada; D Stead, Simon Fraser University, Canada

Tools for validating and creating reliable fault models J Danielson, D Kinakin, I Stilwell, BGC Engineering Inc., Canada

Rock mass behaviour of deep mining slopes: a conceptual model and implications R Rimmelin, The University of Queensland and BHP, Australia; J Vallejos, University of Chile/Advanced Mining Technology Center, Chile

Bayesian approach for the assessment of sufficiency of geotechnical data JF Contreras, SRK Consulting, Australia; M Serati, DJ Williams, The University of Queensland, Australia

NUMERICAL ANALYSIS, IN SITU STRESS AND DISPLACEMENT DESIGN OF SLOPES (1)

A new approach to simulate the dynamic response of high-tensile chain-link drapery systems S Tahmasbi, A Giacomini, University of Newcastle, Australia; R Bucher, Geobrugg Australia Pty Ltd, Australia; O Buzzi, University of Newcastle, Australia

Application of a hybrid approach to the design of anchored wire meshes on steep slopes A Galli, Politecnico di Milano, Italy; M Deana, Officine Maccareferi SpA, Italy; N Mazzon, Maccareferi Innovation Center, Italy

Steep wall mining: engineered structures used in the management of rockfall hazards at Kanmantoo Copper Mine BJ Hutchinson, Hillgrove Resources Ltd, Australia; AT Morrison, Geobrugg Australia Pty Ltd, Australia; DS Lucas, Mining One Pty Ltd, Australia

A case study: assessing the impacts of open cut coal mining on the Maryvale Field (Yallourn) Open Cut and Morwell River Diversion through the use of finite element modelling S Narendranathan, J Stirpeovich, GHD Pty Ltd, Australia; S Rastogi, EnergyAustralia Pty Ltd, Australia

Modelled versus observed open cut performance in weak transition rock: The Dubbo Quarry case study D Trani, GHD Pty Ltd and University of Wollongong, Australia; H Hellmuth, J Thompson, GHD Pty Ltd, Australia

Slope performance monitoring and management of a pit wall experiencing large-scale deformations near Kalgoorlie, Western Australia JW Watton, MJ Fowler, PSM, Australia

Continued overleaf...
**PROCESSING OF GEOTECHNICAL DATA AND LIMIT DESIGN (3)**

- Utilising data science to test similarity of rock mass unit strength distributions in the Pilbara; J Hayman, Rio Tinto Iron Ore, Australia
- Assisting better decision-making of geotechnical slope design by using in-house software at BHP Iron Ore; A Maldonado, A Haile, C Meegamarachchi, L Sasmita, BHP Australia
- Mechanical and physical properties of chalk and impacts on mining operations and slope designs; P Ebeling, Holcim Technology Ltd, Switzerland; A Iwanoff, BGW Geotechnik GmbH, Germany
- The effect of anisotropy orientation on the sedimentary rock strength estimated by point load testing strength, Pilbara, Australia; X Gao, Rio Tinto Iron Ore, Australia
- Influence of particle size-shape correlation on the shear strength of scaled samples of coarse mine waste; S Linero, University of Newcastle and SRK Consulting, Australia; S Fityus, University of Newcastle, Australia; JV Simmons, Sherwood Geotechnical and Research Services, Australia; E Azéma, University of Montpellier, France; N Estrada, University of Los Andes, Colombia; J Dixon, Fortescue Metals Group, Australia
- Waste rock characterisation and stability assessments for feasibility level studies; D Dwumfour, J Dixon, Fortescue Metals Group Ltd, Australia; J Mylvaganam, SRK Consulting, Australia
- The intact rock strength of anisotropic rocks in the Pilbara: the use of field estimations, practical limitations of calibrations and statistical bias; A Maldonado, The University of Western Australia, Australia; PM Dight, Australian Centre for Geomechanics, The University of Western Australia, Australia; K Mercer, 3rd Rock Consulting, Australia
- Geotechnical data aggregation and visualisation supporting informed risk management: the one-stop geotech shop; SDN Wessels, R Dixon, Rio Tinto Iron Ore, Australia

**NUMERICAL ANALYSIS, IN SITU STRESS AND DISPLACEMENT DESIGN OF SLOPES (2)**

- Use of discrete fracture networks in 3D numerical modelling for stability analysis in open pits; E Montiel, P Varona, Geocontrol Mineria, Chile; C Fernandez, Z Espinoza, Antofagasta Minerals, Chile
- Numerical back-analysis of highwall instability in an open pit: a case study; JM Kabuya, R Simon, École Polytechnique de Montréal, Canada; J Carvalho, D Haviland, Golder, Canada
- Validation of the improved unified constitutive model for open pit applications; A Ford, DS Lucas, A Vakili, Mining One Pty Ltd, Australia
- Quantifying excavation-induced rock mass damage in large open pits; L Lorig, D Potyondy, Varun, Itasca Consulting Group, Inc., USA
- Understanding the sensitivity of numerical slope stability analyses to geotechnical and other input parameters; DR Wines, Itasca Australia Pty Ltd, Australia
- Automated geolocated identification of polyhedral blocks and their safety factor calculation in open pit mining; F Gonzalez, A Calderon, Antofagasta Minerals, Chile; R Castellon, M Vargas, C Mena, L Orellana, S Wiche, C Calderon, TMMining, Chile
- Discrete fracture network based approaches to assessing inter-ramp design; M Valero, S Rogers, Golder, Canada; KP Lawrence, KM Moffitt, Golder, USA; B Rysdahl, M Gaida, Rio Tinto Kennecott, USA

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<td>P Stacey, Stacey Mining Geotechnical Ltd., Canada</td>
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<td>Numerical modelling of underground and open pit interaction in a gold mine</td>
<td>K He, G Swarbrick, TD Sullivan, PSM, Australia</td>
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<td>SlopeX: a plug-in to simplify and fast-track advanced numerical modelling for open pit applications</td>
<td>A Vakili, Cavroc Pty Ltd, Australia; J Watson, Cavroc Pty Ltd, Canada; B Abedian, Cavroc Pty Ltd, Australia; T Styles, Cavroc Pty Ltd, UK</td>
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<td>Reinforced soil buns as passive protection structures: the New Zealand experience</td>
<td>E Ewe, Geofabrics New Zealand Ltd, New Zealand</td>
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<td>Three-dimensional numerical modelling for successful design of steep slopes at the Kanmantoo copper mine</td>
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<td>ROCKFALL ANALYSIS AND CONTROL</td>
<td>Calibration of a rockfall simulator with a fragmentation model in a real-scale test</td>
<td>G Matos, N Lantada, J Corominas, R Ruiz-Carulla, A Prades, J Gili, Universitat Politècnica de Catalunya, Spain</td>
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<td>Runout of open pit slope failures: an update</td>
<td>J Whittall, BGC Engineering Inc., Canada; A Mitchell, S McDougall, The University of British Columbia, Canada</td>
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<td>A new radar-based system for detecting and tracking rockfall in open pit mines</td>
<td>M Michelini, F Viviani, M Blanchetti, N Coli, L Leoni, IDS GeoRadar s.r.l., Italy; CJ Staple, IDS GeoRadar, USA</td>
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<td>On the use of acoustic records for the automatic detection and early warning of rockfalls</td>
<td>G Ulivieri, S Vezzosi, GeCo S.r.l., Italy; P Farina, Geopapp S.r.l., Italy; L Meier, Geoapraevent AG, Switzerland</td>
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<td>SURFACE WATER AND GROUNDWATER MANAGEMENT, DEPRESSURISATION, MONITORING AND REMEDIATION</td>
<td>Between a rock and a hard place</td>
<td>P Lombard, GHD Pty Ltd, Australia</td>
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<td>Development of a mine dewatering and pit slope depressurisation review process</td>
<td>E Reano, Piteau Associates Peru S.A.C., Peru; G Beale, Piteau Associates UK Ltd, UK; J Dowling, Piteau Associates, USA; LC Tejada, M Lacey, H Hazweze, Freeport-McMoRan Inc., USA</td>
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<td>Development of an integrated workflow for pit slope pore pressure reconciliation</td>
<td>J Dowling, G Beale, P Haas, B Kaya, S Mak, Piteau Associates, USA; LC Tejada, K Kramer, J Johnson, RE Zee, C Palmer, Freeport-McMoRan Inc., USA</td>
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<td>Simulating fracture network permeability in brown-coal slopes</td>
<td>R Hu, SDC Walsh, Monash University, Australia; J Missen, N Anderson, AGL Loy Yang Pty Ltd, Australia</td>
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<td>Outcomes of an aquifer assessment on the M1B aquifer ahead of Loy Yang Mine and considerations for future dewatering/depressurisation</td>
<td>R Turnbull, G Foley, GHD Pty Ltd, Australia; J Missen, AGL Loy Yang Pty Ltd, Australia</td>
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<td>Pit dewatering optimisation of a 3D FEFLOW unstructured groundwater model at geologically complex Antamina mine site in Peru</td>
<td>PM Dufour, DHI Peru SAC and UNINE, Peru; C Aguirre, M Sanchez, Antamina, Peru; A Maqueda, Université de Neuchâtel, Switzerland; JM Zwinger, A Renz, DHI WASY GmbH, Germany; J Cho, Independent Consultant, Canada; D Evans, FloSolutions, Peru</td>
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<td>Three-dimensional slope stability modelling and its interoperability with interferometric radar data to improve geotechnical design</td>
<td>A McQuillan, Roscience Inc., Australia; T Yacoub, Roscience Inc., Canada; N Bar, Gecko Geotechnics Pty Ltd, Australia; N Coli, L Leoni, IDS GeoRadar, Italy; S Ros, J Bu, Newcrest Mining Limited, Papua New Guinea</td>
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<td>Cockatoo Island: pit dewatering and wall depressurisation behind critical seawall infrastructure</td>
<td>C Powell, Newmont Australia, Australia; J Hall, AQ2 Pty Ltd, Australia</td>
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<td>Elimination of structure controlled highwall failures at an open cut coal mine</td>
<td>J Li, BHP, Australia</td>
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<td>Advanced three-dimensional geomechanical and hydrogeological modelling for a deep open pit</td>
<td>L Cotesta, Vale, Canada (formerly Itasca Consulting Canada, Inc.); J Xiang, Itasca Denver Inc., USA; B Paudel, Vale, Canada (formerly Itasca Consulting Canada, Inc.); R Sterrett, Itasca Denver Inc., USA; J Sjöberg, Itasca Consultants AB, Sweden; T Dilov, I Vasilev, Z Yalamov, Ellatzite-Med AD, Bulgaria</td>
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**PROGRAMME® DAY THREE CONTINUED**

**SLOPE DESIGN IMPLEMENTATION, EXCAVATION CONTROL, BLASTING AND LEGACY ISSUES FOR FINAL WALLS; QUALITY CONTROL**

New approach to detect imminent slope failure by utilising coherence attribute measurement on ground-based slope radar *FA Cahyo, R Dwitya, RH Musa, Groundprobe, Indonesia*

The safest way to increase overall pitwall slope *SP Durkin, BT Moore, Safescape, Australia*

Development of an early warning system for shallow landslide in the Grasberg area, Indonesia *P Farina, Geoapp Italia S.r.l, Italy; F Catani, A Rosi, Geoapp Italia S.r.l and Università degli Studi di Firenze, Italy; I Setiawan, A Junaidi, K Afrizal, A Wijayanto, PT Freeport Indonesia, Indonesia*

Integrating unmanned aerial vehicle photogrammetry in design compliance audits and structural modelling of pit walls *F Medinac, K Esmaeili, University of Toronto, Canada*

Utilising satellite-based techniques to identify and monitor slope instabilities: the Fagraskógarfjall and Limnes landslides *H Larkin, N Magnall, A Thomas, R Holley, H McCormack, CGG Satellite Mapping, UK*

Pit wall optimisation and effective wall management strategies at Invincible Open Pit, St Ives Gold Mines *M Abdulai, PG Andrews, D McMahon, E Bona, J Walker, Gold Fields Australia Pty Ltd, Australia*

Optimisation of crest blasting and excavation techniques for controlling spillover at Bingham Canyon Mine *J Morkeh, J Cefalo, K Robertson, Rio Tinto Kennecott Copper, USA*

Monitoring of structurally controlled deformations at the Kanmantoo copper mine *BJ Hutchison, Hillgrove Resources Limited, Australia; J Chambers, Maptek Pty Ltd, Australia*

Addressing pit wall instabilities in Africa’s largest open pit copper mine *GC More O’Ferrall, First Quantum Minerals Ltd, Zambia; NS Simbile, Kansanshi Mining Plc, Zambia*

New satellite sensors for monitoring mining areas: a look at the future *J Morgan, A Boudreau, TRE ALTAMIRA Inc., Canada; MA Verdugo, TRE ALTAMIRA S.L., Spain; F Meloni, D Colombo, TRE ALTAMIRA s.r.l., Italy*

Monitoring applications for safe mining practices: case studies of sub-bench scale failures in hard rock and coal open cut mines *S Gale, L Farrington, Thiess, Australia; P Bergström, Boliden, Finland; M Suikkonen, YARA, Finland; N Boldrini, M Rubino, N Coll, IDS GeoRadar, Italy; S Naude, IDS Georadar, Australia; CJ Stopka, C Preston, IDS GeoRadar, USA*

**Closing address** *PM Dight, Australian Centre for Geomechanics, The University of Western Australia, Australia*

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**Abstracts due 5 April 2021**

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**Second International Slope Stability in Mining Conference**

26–28 October 2021 | Perth, Western Australia

The Second International Slope Stability in Mining Conference (SSIM 2021) will provide a forum for open pit mining practitioners, consultants, researchers and suppliers worldwide to exchange views on best practice and state-of-the-art slope technologies.

Best practice with respect to pit slope investigations, design, implementation and performance monitoring will be discussed during the conference.

Register your expression of interest at [www.acgsurfacemining.com](http://www.acgsurfacemining.com)