



# 2020 International Symposium on Slope Stability in Open Pit Mining and Civil Engineering

## REGISTRATION BROCHURE

View list of 130+ accepted papers online

12–14 May 2020 | Grand Ballroom, Hyatt Regency Perth, Western Australia

Slope Stability 2020 will provide a forum for open pit mining and civil engineering practitioners, consultants, researchers and suppliers worldwide to exchange views on best practice and state-of-the-art slope stability technologies.

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

The ACG is delighted to host this event in Perth again. It has been more than a decade since it was last held in Western Australia.

### KEYNOTE SPEAKERS



#### Carolina Ahumada

Principal Water Management  
BHP

Title: *BHP's mine water management integrated approach to manage risk and optimise resource value*



#### Robert Sharon

Director, Sharon Geotechnical LLC  
Principal Geotechnical Consultant, Piteau Associates USA

Title: *Slope performance monitoring – system design, implementation and quality assurance*



#### Dr John Simmons

Principal  
Sherwood Geotechnical & Research Services

Title: *More on open pit slope stability geomechanics for weak coal measures rocks*



#### Tim Sullivan

Principal  
PSM

Title: *Hydromechanical coupling concepts for mine slopes*

### SYMPOSIUM CHAIR



#### Professor Phil Dight

Professor of Geotechnical Engineering  
Australian Centre for Geomechanics  
The University of Western Australia, Australia

MONDAY   11 MAY	TUESDAY   12 MAY	WEDNESDAY   13 MAY	THURSDAY   14 MAY	FRIDAY   15 MAY
Instrumentation and Slope Monitoring Workshop	2020 International Symposium on Slope Stability in Open Pit Mining and Civil Engineering			Risk-Based Design and Management of Open Pit Slopes Workshop
				Newmont Australia – Boddington Gold Mine Site Visit

Symposium Dinner

## KEYNOTE PAPERS

BHP's Mine Water Management integrated approach to manage risk and optimise resource value *C Ahumada Calderon, BHP, Australia*

Slope performance monitoring: system design, implementation and quality assurance *R Sharon, Sharon Geotechnical LLC, USA*

More on open pit slope stability geomechanics for weak coal measure rocks *J Simmons, Sherwood Geotechnical and Research Services, Australia*

Hydromechanical coupling concepts for mine slopes *T Sullivan, PSM, Australia*

## SAFETY AND RISK MANAGEMENT

Practical waste rock dump and stockpile management in high rainfall and seismic regions of Papua New Guinea *N Bar, Gecko Geotechnics, Australia; J Semi, M Koek, Ok Tedi Mining Limited, Papua New Guinea; G Owusu-Bempah, A Day, Harmony Gold, Papua New Guinea; S Nicoll, J Bu, Newcrest Mining Limited, Papua New Guinea*

Downhole monitoring with enhanced network smart markers in an open pit *T Beingessner, R Yost, Teck Resources Ltd., Canada; S Steffen, D Whiteman, Elexon Mining, Australia; A Thomas, M Royle, SRK Consulting Inc., Canada; E Widzyk-Capehart, University of Chile, Chile*

Risk management in a large-scale slope instability with active pushbacks in an open pit *A Cabrejo, GroundProbe North America, USA; Y Gunaris, Compañía Minera Doña Inés de Collahuasi, Chile; P Ballett, GroundProbe Pty Ltd, Australia; J Perez, Compañía Minera Doña Inés de Collahuasi, Chile; G Stickley, GroundProbe Pty Ltd, Australia*

Risk management in a large-scale slope instability with active pushbacks in an open pit *JA Calderón, JJ Muñoz, Minera Escondida Ltda., Chile*

Trigger action response plan development and optimisation: case studies from the Bingham Canyon Mine *GK Chapin, KM Bakken, MG Abrahams, Rio Tinto Kennecott Copper, USA*

The strain criteria formula: the derivation of indicative displacement alarm thresholds for slope performance and instability monitoring *S Coetsee, Reutech Mining, South Africa; R Armstrong, P Terbrugge, SRK Consulting (South Africa) (Pty Ltd), South Africa*

Geotechnical risk management for Victor Mine closure *M Desjardins, De Beers Group, Canada; P de Graaf, De Beers Group, South Africa; G Beale, Piteau Associates, UK; M Rougier, Golder, Canada*

Implications of slope damage in 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*

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

Development of an early warning system for shallow landslide hazard in the Tembapapura area, Indonesia *P Farina, Geoapp s.r.l., Italy; F Catani, A Rosi, Geoapp s.r.l., Italy & University of Florence, Italy; I Setiawan, A Junaidi, K Afrizal, A Wijayanto, PT Freeport Indonesia, Indonesia*

Brumadinho Dam InSAR study: analysis of TerraSAR-X, COSMOSkyMed & Sentinel-1 SAR images preceding the collapse *D Holden, S Donegan, A Pon, 3vGeomatics Inc., Canada*

InSAR investigation of sackung-like features and debris flows in the vicinity of Hawkesbury Island and Hartley Bay, British Columbia, Canada: reducing landslide and tsunami risks for coastal communities and vulnerable infrastructure *D Huntley, D Rotheram-Clarke, P Bobrowsky, G Lintern, R MacLeod, C Brillon, Geological Survey of Canada, Canada*

Evolution and management of large-scale instability: a case study from Ok Tedi *G Kennedy, D Casagrande, PSM, Australia*

Use of laser scanner technology as part of the slope stability risk management strategy at Letšeng Diamond Mine *N Lefu, Letšeng Diamonds, Lesotho; V Nokwe, Maptek, South Africa*

InSAR in the clouds: satellite-based monitoring at Grasberg Mine *JM Leighton, 3vGeomatics Inc., Canada; M Sullivan, Freeport McMoran, Indonesia*

Regulation of open pit slope stability in Russia *A Makarov, I Livinsky, V Spirin, SRK Consulting (Russia) Ltd, Russia; A Pavlovich, Saint-Petersburg Mining University, Russia*

Management of geotechnical hazards through embracing technology and innovative thinking *KT Mandisodza, Evolution Mining, Australia*

Slope monitoring at the Serra Sul Iron Ore Project, S11D: a case study *FS Moragas, E Friguette, WJ Souza, AHCR Castro, Vale S.A., Brazil*

Waterproofing and slope protection in landfills and reservoirs *D Romeo, Officine Maccaferri S.p.A., Italy; RM Ratnakar, Maccaferri S.P.A. Asia, India*

Managing ice walls and other operational challenges while optimising Victor Mine late stage opportunities *M Rougier, Golder, Canada; P de Graaf, The De Beers Group of Companies, South Africa; M Desjardins, The De Beers Group of Companies, Canada; M O'Leary, Mount Polley Mining Corporation, Canada; N Yugo, Independent Consultant, Canada*

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*

i<sup>2</sup>MON: integrated monitoring for the detection of ground and surface displacements caused by coal mining *D Schröder, K Zimmermann, S Bock, DMT GmbH & Co. KG, Germany; J Klonowski, University of Applied Sciences, Germany*

Analysis of velocity and acceleration trends using slope stability radars to identify failure signatures to better inform trigger action response plans *R Shellam, SRK Consulting (UK) Limited, UK; J Coggan, University of Exeter, UK*

Remote monitoring of tailings storage facilities using multi-sensor satellite data *A Thomas, H Larkin, N Magnall, CGG Satellite Mapping, UK*

Economic consequences of geotechnical instabilities in open cut coal mines *K Young, A Robotham, G Virk, BHP, Australia*

## ASSESSMENT AND IMPLICATIONS FOR UNCERTAINTY IN DESIGN

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, BHP, Chile; R Castellón, M Vargas, TIMining, Chile*

An overview of bench design for cut slopes: a methodology for assigning nominal and static shear strength parameters to attain dynamic factor of safety and probability of failure values for advanced dataset assessment *SA Coetsee, Reutech Mining, South Africa*

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

Development and application of a reliability based approach to slope design acceptance criteria at the Bingham Canyon Mine *M Gaida, D Cambio, Rio Tinto Kennecott Copper, USA; ME Robotham, Rio Tinto, Australia; V Pere, Golder, Australia*

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*

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

Three-dimensional limit equilibrium method rock slope stability analysis using generalised anisotropic material model NS Kumar, MAM Ismail, Universiti Sains Malaysia, Malaysia

Epistemic uncertainty propagation in slope stability analysis and implications in safety margins CE Valderrama, M Cofré, E Hormazabal, R Álvarez, SRK Consulting (Chile) S.A., Chile

#### PROCESSING AND GEOTECHNICAL DATA AND LIMIT DESIGN

Influence of the hydrothermal alteration rocks on the stability of an open pit mine, south of Peru: a case study S Castro, C Huaman, Anddes Associates, Peru

Case study: analysis of a highwall toppling failure and development of a successful mine re-entry plan using RS2, RocFall and Dan-W at a coal mine in Canada C Clayton, A Jackson, J Price, Tetra Tech Canada Inc., Canada; A Bidwell, Teck Coal Ltd., Canada; D Elmo, University of British Columbia, Canada

Bayesian approach for the assessment of sufficiency of geotechnical data L-F Contreras, The University of Queensland, Australia & SRK Consulting (South Africa) (Pty Ltd), South Africa; M Serati, D Williams, The University of Queensland, Australia

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

Improving televiewer data acquisition to optimise slope designs in the Pilbara S Dennett, H Donders, L Fisher, J Thomson, BHP, Australia

Waste rock characterisation and stability assessments for feasibility level studies J Dixon, D Dwumfour, Fortescue Metals Group, Australia; J Mylvaganam, SRK Consulting (Australasia) Pty Ltd, Australia

Geotechnical evaluation of east wall of Cerro Corona's open pit J Dueñas, G Becerra, J Ordoñez, J Dueñas, Gold Fields, Peru; PG Andrews, Gold Fields Australia Pty Ltd, Australia

Mechanical and physical properties of chalk and impacts on slope designs P Ebeling, Holcim Technology Ltd, Switzerland; A Iwanoff, BGW Geotechnik GmbH, Germany

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

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, University of Florence, Italy

Structural data bias assessment at Jwaneng Mine K Gabanakgosi, O Mogorosi, K Rametlae, B Boitshepo, OM Barei, Debswana Diamond Company, Botswana

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

Utilising data science to test similarity of rock mass unit strength distributions in the Pilbara L J Hayman 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 & SRK Consulting (Australasia) Pty Ltd, Australia; S Fityus, University of Newcastle, Australia; J Simmons, Sherwood Geotechnical and Research Services, Australia; E Azema, University of Montpellier, France; N Estrada, University of Los Andes, Colombia; J Dixon, Fortescue Metals Group, 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, PM Dight, Australian Centre for Geomechanics and The University of Western Australia, Australia; K Mercer, 3rd Rock Consulting, Australia

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

Assisting better decision-making of geotechnical slope design using in-house technology software at BHP Iron Ore A Maldonado, A Haile, C Meegamarachchi, L Sasmita, BHP, Australia

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

Determination of the parameters of pit walls with reverse steeply dipping stratification AA Pavlovich, NY Melnikov, Saint-Petersburg Mining University, Russia

Rock mass behaviour at great depth: a conceptual model and implications R Rimmelin, The University of Queensland and BHP, Australia

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

Characterisation of foliated rock masses using implicit modelling to guide geotechnical domaining and slope design E Saunders, A LaRiche, T Shapka-Fells, W Barnett, SRK Consulting (Canada) Inc., Canada

Slope Design Assessment, Mining Strategy, and Development of Geotechnical Setback Criteria for Excavation of Steep, Natural Escarpments in Rugged Mountainous Terrain MF Scholz, BW Gilmore, MNT King, PM Hawley, Piteau Associates, Canada; C Aguirre-Freyre Compañía Minera Antamina S.A., Perú

Introducing G.R.E.T.A.: the new Geo RESistivimeter for time-lapse analysis G Tresoldi, Politecnico di Milano, Italy; A Hojat, Shahid Bahonar University of Kerman, Iran; L Zanzi, Politecnico di Milano, Italy; A Certo, LSI Lastem s.r.l., Italy

Evolution of a geotechnical model for slope design in an active volcanic environment FM Weir, MJ Fowler, TD Sullivan, M Kobler, PSM, 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

Directional Hoek-Brown rock mass strength: GSI adjustment NRP Baczynski, Prime Geotechnics Pty Ltd, Australia

Computational tools for the estimation of factor of safety and location of the critical failure surface for slopes in rock masses that satisfy the Hoek-Brown failure criterion C Carranza-Torres, Department of Civil Engineering, University of Minnesota, USA; E Hormazabal, SRK Consulting (Chile) S.A., Chile

Case study: back-analysis of a historical open pit highwall failure at a coal mine in Canada C Clayton, R Barnett, Tetra Tech Canada Inc., Canada; M Slater, Teck Coal Ltd., Canada

Automated geo-localised identification of polyhedral blocks and their safety factor calculation in open pit mining F González, A Calderón, Antofagasta Minerals, Chile; R Castellón, M Vargas, C Mena, L Orellana, S Wiche, C Calderón, TIMining, Chile

Validation of the improved unified constitutive model for open pit applications A Ford, D Lucas, A Vakili, Mining One Pty Ltd, Australia

Hybrid design approaches for anchored wire meshes: a simplified two block method for steep slopes A Galli, Politecnico di Milano, Italy; M Deana, Officine Maccaferri S.p.A., Italy; N Mazzon, Maccaferri Innovation Centre., Italy

Numerical modelling of underground and open pit interaction in a gold mine *K He, G Swarbrick, T Sullivan, PSM, Australia*

Geotechnical design considerations for 'nose' geometries in pit design *A Huaman, SRK Consulting (South Africa), South Africa*

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

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*

Quantifying excavation-induced rock mass damage in large open pits *L Lorig, D Potyondy, Varun, Itasca Consulting Group Inc., USA*

Use of discrete fracture networks in three-dimensional numerical modelling for stability analysis in open pit mining *E Montiel, P Varona, Geocontrol Minería, Chile; C Fernandez, Z Espinoza, Antofagasta Minerals, Chile*

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 Stipcevic, GHD Pty Ltd Australia, Australia; S Ristogi, EnergyAustralia, Australia*

Back-analysis of in-pit dump slope failure and remediation results at Bara Anugrah Sejahtera open pit coal mine, Indonesia *L Rachmad, D Aryanda, GEOMINE Mining and Geotechnical Consultant, Indonesia; M Daraji, Titan Group, Indonesia*

Engineering geology investigation and numerical modelling design of the Ramp 12 Highwall *B Roache, Mining One Consultants Pty Ltd, Australia; AR Johnstone, BHP, Australia*

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

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

SlopeX: a plug-in to simplify and fast-track advanced numerical modelling for open pit applications *A Vakili, Cavroc Pty Ltd, Australia; J Watson, Cavroc Pty Ltd, Canada; B Abedian, Cavroc Pty Ltd, Australia; T Styles, Cavroc Pty Ltd, UK*

Discrete fracture network based approaches to assessing inter-ramp design *M Valerio, S Rogers, Golder, Canada; KP Lawrence, KM Moffitt, Golder, USA; B Rysdahl, M Gaida, Rio Tinto Kennecott Copper, USA*

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

Understanding the sensitivity of numerical slope stability analyses to geotechnical and other input parameters *DR Wines, Itasca Australia Pty Ltd, Australia*

## OPEN PIT/UNDERGROUND INTERACTION

Investigating the influence of the construction of a tunnel on the stability of its adjacent slope: case study - Haji Abad tunnel, Iran *M Rezvani, A Golshani, Tarbiat Modares University, Iran*

## SURFACE WATER AND GROUNDWATER MANAGEMENT, DEPRESSURISATION, MONITORING AND REMEDIATION

Assessment of depressurisation approaches at Debswana's Orapa Mine, Botswana *M Anderson, B Maswabi, Debswana Diamond Company, Botswana; H Liu, Itasca Denver Inc., USA*

A methodology for assessing rainfall-induced pore pressure changes in open pit slopes *J Bellin, M Raynor, R Kettle, SRK Consulting UK Ltd, UK; K Tasoren, IAMGOLD Corporation, Suriname*

Anglo American framework for strategic dewatering plans *C Cintolesi, Anglo American, Chile; G Beale, Piteau Associates, UK; J Dowling, Piteau Associates, USA; J Kotze, Anglo American, South Africa; A Rowland, Piteau Associates, South Africa; S Mansell, Piteau Associates, Chile*

Advanced three-dimensional geomechanical and hydrogeological modelling for a deep open pit *L Cotesta, Vale, Canada; J Xiang, Itasca Denver Inc., USA; B Paudel, Vale, Canada; R Sterrett, Itasca Denver Inc., USA; J Sjöberg, Itasca Consultants AB, Sweden; T Dilov, I Vasilev, Z Yalamov, Ellatzite-Med AD, Bulgaria*

Fast assessment of pore pressures and inflows in open pit slopes using smart models *ER De Sousa, DHI Water & Environment, Australia*

Uncertainty analysis techniques in pore pressure modelling for slope stability: state-of-the-art and future directions *ER De Sousa, DHI Water & Environment, Australia; J Doherty, Watermark Numerical Computing, Australia*

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

Development of an integrated workflow for pit slope pore pressure reconciliation *J Dowling, G Beale, P Haas, B Kaya, Piteau Associates, USA; LC Tejada, K Cramer, J Johnson, RE Zea, C Palmer, Freeport McMoRan, USA*

Pit dewatering optimisation of a 3D FEFLOW unstructured groundwater model at geologically complex Antamina mine site in Peru *RM Dufour, DHI Peru SAC & University of Neuchâtel, Peru; CF Aguirre, M Sanchez, Antamina, Peru; A Maqueda, University of Neuchâtel, Switzerland; JM Zwinger, A Renz, DHI, Germany; J Cho, Independent Consultant, Canada*

Simulating fracture network permeability in brown coal slopes *R Hu, SDC Walsh, Monash University, Australia*

Elimination of structure controlled highwall failures at an open cut coal mine *J Li, BHP, Australia*

Design and implementation of cost-effective depressurisation systems at Debswana's Jwaneng Mine, Botswana *O Mabote, L Kgotlhang, B Maswabi, Debswana Diamond Company, Botswana; H Liu, Itasca Denver, Inc., USA*

Three-dimensional slope stability modelling and its interoperability with interferometric radar data to improve geotechnical design *A McQuillan, T Yacoub, Rocscience Inc., Canada; N Bar, Gecko Geotechnics, Australia; N Coli, L Leoni, IDS GeoRadar, Italy; S Rea, J Bu, Newcrest Mining Limited, Papua New Guinea*

Cockatoo Island: pit dewatering and wall depressurisation behind critical seawall infrastructure *C Powell, Geomech Consulting Services, Australia; J Hall, AQ2 Pty Ltd, Australia*

Impact of pore water pressure on pit slope stability of a coal mine *K Rana, IL Muthreja, Visvesvaraya National Institute of Technology, India*

A review of vibrating wire piezometer usage in ultra-low permeability and heterogenous fractured rock environments *M Raynor, L Sultanov, H El Idrysy, SRK Consulting, United Kingdom*

Development of a mine dewatering and pit slope depressurisation review process *E Reano, Piteau Associates, Peru; G Beale, Piteau Associates, UK; J Dowling, Piteau Associates, USA; LC Tejada, Freeport McMoRan, USA*

Outcomes of an aquifer assessment on the M1B aquifer ahead of Loy Yang Mine, and considerations for future dewatering/depressurisation *R Turnbull, G Foley, GHD Pty Ltd, Australia; J Missen, AGL, Australia*

Slope depressurisation at Sishen Mine, Northern Cape, South Africa *TH White, M Bester, Kumba Iron Ore, South Africa*

#### ROCKFALL ANALYSIS AND CONTROL

Scaling the heights: developing a remote highwall scaling machine for use at the Savage River Mine *MS Anderson, Grange Resources, Australia; C Johnson, Jayben, Australia*

Risk analysis affectation to people and/or equipment due to rockfall *EG Bermedo, MM Schellman, DC Diaz, Anglo American, Chile*

Blue water ramp access recovery affected by rockfall *DC Diaz, EG Bermedo, MM Schellman, Anglo American, Chile*

Reinforced soil bund as passive protection structures: the New Zealand experience *E Ewe, Geofabrics NZ Ltd, New Zealand*

Analysis of the effect of backbreak on rockfall trajectories *I García, SRK Consulting (UK) Pty Ltd, UK; S Pastine, SRK Consulting (Argentina) S.A., Argentina*

Slope design and control of rockfall hazards in a challenging structural setting at the Kanmantoo copper mine, South Australia *DS Lucas, A Vakili, Mining One Consultants Pty Ltd, Australia; BJ Hutchison, Hillgrove Resources Ltd, Australia*

Calibration of a rockfall simulator with a fragmentation model in a real scale test *G Matas, N Lantada, J Corominas, R Ruiz-Carulla, A Prades, J Gili, Universitat Politecnica de Catalunya, Spain*

RockSpot: a new radar-based method for detecting and tracking rockfall in open pit mines *A Michelini, F Viviani, M Bianchetti, N Coli, L Leoni, IDS GeoRadar, Italy; CJ Stopka, IDS GeoRadar, USA*

Rockfall risk management: a case study from Morenci Mine, Arizona *A Moore, RE Zea, LC Tejada, C Palmer, Freeport McMoRan, Inc., USA; D Morrison, J Connolly, Call & Nicholas Inc., USA*

Testing the berm effectiveness through rockfall trials and its calibration *A Quilodran, JJ Calderon, JJ Muñoz, Minera Escondida Ltda., Chile*

On the use of acoustic records for the automatic detection and early warning of rockfalls *G Ulivieri, S Vezzosi, Geco s.r.l., Italy; P Farina, Geoapp s.r.l., Italy; L Meier, GeopraeventAG, Switzerland*

A practical rockfall risk model for open pit mines using the space-time concept *J Venter, ECF Hamman, AngloGold Ashanti, Australia*

Runout of open pit slope failures: an update *J Whittall, BGC Engineering Inc., Canada; A Mitchell, S McDougall, University of British Columbia, Canada*

#### SLOPE STABILITY IN UNSATURATED MATERIALS

Slope stabilisation of steep overburden dumps with significant height in Singrauli coal mines of India: a case study *MR Madhav, JNT University, India; M Korulla, RR Mahajan, Maccaferri Environmental Solutions Pvt. Ltd., India*

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

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

New approach to detect imminent failure by utilising coherence attribute measurement on slope stability radar *FA Cahyo, R Dwitya, RH Musa, GroundProbe, Indonesia*

Machine learning applied to ground motion prediction equation on an open pit mine in Brazil *AQ de Paula, Federal University of Ouro Preto, Brazil & Tetra Tech, Brazil; CT Rodrigues, CAS Braga, Tetra Tech, Brazil; GG Magalhães, Federal University of Ouro Preto, Brazil & Tetra Tech, Brazil; LA Oliveira, Federal University of Rio de Janeiro, Brazil & Tetra Tech, Brazil; SBF Cembraneli, LAP Almeida, Mosaic, Brazil; LS Dias, Federal University of Rio de Janeiro, Brazil & Tetra Tech, Brazil*

Exploitation of InSAR techniques combined with in situ sensors to improve safety and productivity in mining operations *J Duro, R Iglesias, D Monells, R Calvo, DARES Technology, Spain*

Monitoring applications for safe mining practices: case studies of sub-bench scale failures in hard rock and open cut coal mines *S Gale, L Farrington, Thiess Pty Ltd, Australia; P Bergström, Boliden Mineral AB, Finland; M Suikkanen, YARA Suomi Oy, Finland; N Boldrini, M Rubino, N Coli, IDS GeoRadar, Italy; S Naude, IDS Georadar s.r.l., Australia; C, C Preston, IDS GeoRadar, USA*

Back-analysis of a major spoil failure at an open pit lignite mine *JD Greenwood, MB Haggerty, JL Workman, Barr Engineering Co., USA*

Evaluation and management of toppling failures at the McArthur River Mine, Northern Territory *CEV Heaven, DBM Bran, WA Norrie, Glencore, Australia*

Structural controlled deformations at the Kanmantoo Copper Mine *BJ Hutchison, Hillgrove Resources Ltd, Australia; J Chambers, Mapek, Australia*

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, CCG Satellite Mapping, UK*

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

Satellite radar monitoring with InSAR sensor: indication of areas with potential failure – case study Carajás, Brazil *FS Moragas, Vale S.A., Brazil*

Inverse velocity technic as mine slope collapse forecast: a case study *FS Moragas, A Silva, PMS Lopes, MHA Pires, Vale S.A., Brazil; DO Sousa, Vale S.A., Brazil*

Addressing pit wall instabilities in Africa's largest open pit copper mine *GC More O'Ferrall, First Quantum Minerals Limited, 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, Canada; MA Verdugo, TRE ALTAMIRA S.L., Spain; F Meloni, D Colombo, TRE ALTAMIRA s.r.l., Italy*

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*

Geogrid reinforced soil walls in Myanmar: an overview *S Ramasamy, F Rosiello, D Ghoshal, Maccaferri Asia, Malaysia*

Factors to be considered when applying atmospheric corrections to distance measurements: a case study of the Leica GeoMoS installation at Orapa, Letlhakane and Damtshaa mines *O Randall, Debswana, Botswana; H Thomas, University of Witwatersrand, South Africa*

# Associated Events

## INSTRUMENTATION AND SLOPE MONITORING WORKSHOP

Monday 11 May 2020 | Hyatt Regency Perth, Western Australia

This ACG workshop will focus on new developments relating to conventional terrestrial monitoring systems such as open pit radars, prisms, laser scanning, and photogrammetry, as well as the integration of the different types of these monitoring systems and their interpretation. Application examples of many companies providing these new technologies include land cover determination, feature extraction, persistent change detection and monitoring, terrain slope characterisation, soils modelling and saturated ground detection.

### Workshop Facilitator



#### Professor Phil Dight

Professor of Geotechnical Engineering  
Australian Centre for Geomechanics  
The University of Western Australia,  
Australia

Preliminary Programme*	
07:30	REGISTRATION
08:20	Welcome and introduction <i>Professor Phil Dight, Australian Centre for Geomechanics</i>
08:30	The evolution of the monitoring system in Escondida <i>Rigo Rimmelin, BHP</i>
09:00	Reliable slope monitoring with radar satellites: current and future of InSAR technology for the mining industry <i>Dr Javier Duro, DARES Technology, Spain</i>
09:30	InSAR in the framework of a modern monitoring strategy <i>Davide Colombo, Tre Altamira s.r.l., Italy</i>
10:00	MORNING BREAK
10:30	Applications and development of the Maptek Sentry LiDAR-based monitoring system at the Kanmantoo Copper Mine <i>Bruce Hutchinson, BJH Geotechnical Services Pty Ltd</i>
11:00	Leica Geosystems' monitoring solutions <i>Dr Lidija Spiranec, Leica Geosystems AG, Switzerland</i>
11:30	The key to success: selection of appropriate trigger levels <i>Dr Felicia Weir, PSM</i>
12:00	LUNCH
13:00	Behind the wall: how cloud technology is improving the understanding of causality in slope stability monitoring <i>Alex Pienaar, sensemetrics, USA</i>
13:30	Case study: the new SSR-OMNI and Precision Atmospherics algorithm, and its application in a tailings dam in Chile <i>Albert Cabrejo, GroundProbe North America, USA</i>
14:00	The qualification and quantification of risk mitigation efforts with specific emphasis on the application radar technology <i>Sharla Coetsee, Reutech Mining, South Africa</i>
14:30	AFTERNOON BREAK
15:00	The use of ground movement monitoring instrumentation to calibrate a finite element method model at the Yallourn Open Cut <i>Jack Stipceovich, GHD Pty Ltd</i>
15:30	Improving the understanding of movement kinematics by combining multiple Groundbased IBIS radar systems <i>Niccolò Coli, IDS GeoRadar, Italy</i>
16:30	WORKSHOP WRAP UP

\*Preliminary programme is subject to change. View received abstracts at [www.slopestability2020.com/instrumentation-workshop/](http://www.slopestability2020.com/instrumentation-workshop/)

## RISK-BASED DESIGN AND MANAGEMENT OF OPEN PIT SLOPES WORKSHOP

Friday 15 May 2020 | Hyatt Regency Perth, Western Australia

Within the mining community, geotechnical risk is often underappreciated, sometimes ignored and seldom properly quantified. The uncertainty and variability that engineers need to deal with necessitate a rigorous process of quantification or, in the very least, robustly qualifying likelihoods and consequences. There appears also to be a large gap between the state-of-the-art and the state of general practice when it comes to the qualification and quantification of geotechnical risk. The aim of this workshop is to provide a forum to discuss the methods used to design for geotechnical risk and those used to manage these risks; to identify shortcomings; and to close the gap between the state-of-the-art and the state-of-practice.

### Workshop Facilitator



#### Professor Phil Dight

Professor of Geotechnical Engineering  
Australian Centre for Geomechanics  
The University of Western Australia,  
Australia

Preliminary Programme*	
07:30	REGISTRATION
08:20	Welcome and introduction <i>Professor Phil Dight, Australian Centre for Geomechanics</i>
08:30	Risk as a rock engineering design criterion <i>Associate Professor Johan Wesseloo, Australian Centre for Geomechanics</i>
09:00	The future of risk-based design in the era of prescribed factors of safety <i>Adjunct Professor Tim Sullivan, PSM</i>
09:30	Risk-based water management in open pit mining <i>Jon Hall, AQ2 Pty Ltd</i>
10:00	Failure investigations – where do you start? <i>Emrich Hamman, AngloGold Ashanti Ltd</i>
10:30	Uncertainty, design reliability and slope risk <i>Michael Dunn, Debswana</i>
11:00	Slope risk and collaborative decision-making under uncertainty <i>Dr Stephan Arndt, Dassault Systèmes</i>
11:30	Risk identification and management in a large open pit <i>Dr Felicia Weir, PSM</i>
12:30	LUNCH
13:30	Practical considerations for applying and understanding risk-based design <i>Julian Venter, AngloGold Ashanti Ltd</i>
14:00	Risk management: is it a number's game, a process or judgement? <i>Alex Duran, PSM</i>
14:30	Accounting for sources of uncertainty in slope design: from theory to practice <i>Arturo Maldonado, BHP</i>
15:00	AFTERNOON BREAK
15:30	How to determine the minimal number of specimens required for laboratory testing of rock properties and support the classification of rock mass domains <i>David Gaudreau, Newmont Goldcorp</i>
16:00	Lower and upper bounds for slope stability analysis based on the Hoek-Brown criterion <i>Associate Professor Ali Karrech, The University of Western Australia</i>
17:00	WORKSHOP WRAP UP

\*Preliminary programme is subject to change. View received abstracts at [www.slopestability2020.com/risk-workshop/](http://www.slopestability2020.com/risk-workshop/)

# Associated Events

## SYMPOSIUM DINNER

Wednesday 13 May 2020 | Optus Stadium, Perth

Time: 6:30 pm (subject to change)

Venue: Optus Stadium, Perth - Champions Terrace for pre-dinner drinks, Ballroom Three for sit-down dinner

The symposium dinner provides Slope Stability 2020 delegates and partners the opportunity to network and enjoy fine dining in one of Perth's newest and most exciting venues, recently voted the "World's Most Beautiful Stadium".

Dinner Supporting Sponsor



## NEWMONT AUSTRALIA BODDINGTON SITE VISIT

Friday 15 May 2020 | Boddington, Western Australia

Newmont Goldcorp have generously offered their Boddington operations for a site visit for attendees only of the International Symposium on Slope Stability in Open Pit Mining and Civil Engineering.

More information on the site visit can be found at [www.slopestability2020.com/site-visit/](http://www.slopestability2020.com/site-visit/)



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REGISTRATION FORM

Slope Stability 2020 (2025) | 12-14 May 2020

Online registrations are available at [slopestability2020.com/registrations](http://slopestability2020.com/registrations)

CONTACT DETAILS

Please print. \*denotes mandatory fields.

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

\*Family Name \_\_\_\_\_

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\*Position \_\_\_\_\_

\*Organisation \_\_\_\_\_

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\*All confirmations/event updates will be sent via email.

Registrant contact details are intended to be published in the event's 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 SS 2020 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 Australian visas, please visit [acg.uwa.edu.au/about-events-and-courses/](http://acg.uwa.edu.au/about-events-and-courses/)

The registration form for the Newmont Goldcorp Boddington Site Visit is available at [slopestability2020.com/site-visit](http://slopestability2020.com/site-visit)

DELEGATE CANCELLATIONS

Up to 8 days before event commencement: an administration fee of AUD 150 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.

Delegate Terms and Conditions are available at [acg.uwa.edu.au/disclaimer](http://acg.uwa.edu.au/disclaimer)

PAYMENT

Total payment AUD \_\_\_\_\_

Payment to be received by 8 May 2020. All bank fees are the responsibility of the registrant.

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Electronic Funds Transfer (EFT)

Please return this completed form to [info-acg@uwa.edu.au](mailto:info-acg@uwa.edu.au) and the ACG will send you an invoice with EFT details included. PO# (if required) \_\_\_\_\_

Credit Card

Register online at [slopestability2020.com/registrations/](http://slopestability2020.com/registrations/) or alternatively, return this completed form to [info-acg@uwa.edu.au](mailto:info-acg@uwa.edu.au) and phone us on +61 8 6488 3300 to make payment (Visa and Mastercard are the only cards we accept).

	Earlybird Paid until 3 April 2020	Standard Paid after 3 April 2020
Standard	<input type="checkbox"/> 1,980	<input type="checkbox"/> 2,200
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Student^	<input type="checkbox"/> 440	<input type="checkbox"/> 660

† Please visit [www.acg.uwa.edu.au/corporate-affiliate/](http://www.acg.uwa.edu.au/corporate-affiliate/) to view the list of ACG Corporate Affiliates.

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

All full registrations will receive luncheons and refreshments.

Please notify us below of any special dietary requirements.

SS 2020 Symposium Dinner  
13 May 2020  154

Symposium papers will be accessible at [papers.acg.uwa.edu.au](http://papers.acg.uwa.edu.au) from 4 May 2020. If you would like a printed copy of the proceedings, please tick the box below.

SS 2020 Printed Proceedings  
(Softbound, colour) (Symposium special)  220

Instrumentation and Slope Monitoring Workshop (2024)  
11 May 2020

	Earlybird Paid until 3 April 2020	Standard Paid after 3 April 2020
Standard	<input type="checkbox"/> 880	<input type="checkbox"/> 1100
ACG Affiliate†	<input type="checkbox"/> 660	<input type="checkbox"/> 880
Student^	<input type="checkbox"/> 220	<input type="checkbox"/> 440

Risk-Based Design and Management of Open Pit Slopes  
Workshop (2026) 15 May 2020

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Standard	<input type="checkbox"/> 880	<input type="checkbox"/> 1100
ACG Affiliate†	<input type="checkbox"/> 660	<input type="checkbox"/> 880
Student^	<input type="checkbox"/> 220	<input type="checkbox"/> 440

How to register:

Australian Centre for Geomechanics  
The University of Western Australia  
35 Stirling Highway (M600)  
Crawley WA 6009

+61 8 6488 3300

[info-acg@uwa.edu.au](mailto:info-acg@uwa.edu.au)

[www.slopestability2020.com](http://www.slopestability2020.com)