Table of Contents

iii Australian Centre for Geomechanics
v International Organising Committee
vii Technical Reviewers
ix Preface
xi Sponsors

Keynote addresses

3 Critical review of design principles for rock support in burst-prone ground – time to rethink!
P.K. Kaiser, M. Cai, Bharti School of Engineering, Laurentian University, Canada

39 Deep hard rock mining and rock mechanics challenges
E. Nordlund, Division of Mining and Geotechnical Engineering, Luleå University of Technology, Sweden

57 Applying a ground support and reinforcement design methodology
D. Finn, Newcrest Mining Ltd, Australia

81 Guidelines for numerical modelling of rock support for mines
L.J. Lorig, Itasca International, Inc., USA; P. Varona, formerly of Itasca Consultores S. L., Spain

Squeezing ground

109 Assessment of the influence of drift orientation on observed levels of squeezing in hard rock mines
J. Hadjigeorgiou, E. Karampinos, Lassonde Institute of Mining, University of Toronto, Canada; P. Turcotte, F. Mercier-Langevin, Agnico-Eagle Mines Ltd., Canada

119 Lapa Mine – ground control practices in extreme squeezing ground
F. Mercier-Langevin, D. Wilson, Agnico-Eagle Mines Ltd., Canada

133 Shotcrete ribs and cemented rock fill ground control methods for stoping in weak squeezing rock at Wattle Dam Gold Mine
P. Marlow, Ramelius Resources Pty Ltd, Australia; P.A. Mikula, Mikula Geotechnics Pty Ltd, Australia

149 Mining in consolidated and presupported karstified ground conditions
J.F. Talbot, J. Burke, Vedanta Resources Lisheen Mine, Ireland

163 Investigation of expanding Split Sets
G.R. Davison, P.G. Fuller, Mining One Pty Ltd, Australia

171 When friction is no longer enough
J.H. Graaf, Golder Associates Pty Ltd, Australia; S. Van Der Merwe, Xstrata Nickel Australasia, Australia

Ground support testing

187 Static and dynamic testing of welded and woven mesh for rock support
E. Villaescusa, A.G. Thompson, J.R. Player, Western Australian School of Mines, Curtin University/CRC Mining, Australia

197 Dynamic testing of large scale fibrecrete panels
E. Villaescusa, A.G. Thompson, J.R. Player, Western Australian School of Mines, Curtin University/CRC Mining, Australia

207 In situ dynamic drop testing of the MD bolt at Mt Charlotte Gold Mine
R. Carlton, Kalgoorlie Consolidated Gold Mines Pty Ltd, Australia; B. Darlington, Sandvik Mining, Australia; P.A. Mikula, Mikula Geotechnics Pty Ltd, Australia

221 Large scale field tests of high-tensile steel wire mesh in combination with dynamic rockbolts subjected to rockburst loading
R. Bucher, Geobrugg Australia Pty Ltd, Australia; M. Cala, AGH University of Science and Technology, Poland; A. Zimmermann, C. Balg, A. Roth, Geobrugg AG, Switzerland

233 A decade of ground support research at the WA School of Mines
E. Villaescusa, A.G. Thompson, J.R. Player, Western Australian School of Mines, Curtin University/CRC Mining, Australia

247 Dynamic testing of fully encapsulated threaded bar – resin and cement grouted
J.R. Player, E. Villaescusa, A.G. Thompson, Western Australian School of Mines, Curtin University/CRC Mining, Australia

265 Dynamic testing of Tekseal high yield grout to provide an orepass plug designed for impact
I.V.S. Mutton, Minova Australia, Australia; A.M. Remennikov, University of Wollongong, Australia; D. Pateman, Minova Australia, Australia

Dynamic support

287 Towards an understanding of dynamic demand on ground support
Y. Potvin, J. Wesseloo, Australian Centre for Geomechanics, The University of Western Australia, Australia

305 Design, development and testing of the JTech bolt for use in static, quasi-static and dynamic domains
T. Roberts, A. Dodds, Jennmar Australia Pty Ltd, Australia

323 High capacity yielding bolt support for rockburst prone workings
J. Oldsen, Jennmar Corporation, USA; T. Roberts, Jennmar Australia Pty Ltd, Australia

Support design and practices

337 Role of defects in rock mass classification
J. Jakubec, SRK Consulting (Canada) Ltd., Canada

345 Uncertainty in ground support design and implementation in underground mining
M.J. Dunn, SRK Consulting (Australasia) Pty Ltd, Australia

359 Excavation curvature and roughness – their influence on the performance of mesh and mesh reinforced shotcrete
C.R. Windsor, Western Australian School of Mines, Curtin University/CRC Mining, Australia; A. Roth, Geobrugg AG, Switzerland

373 Evaluation of the strength reduction method for US coal mine entry stability analysis
G.S. Esterhuizen, T.S. Bajpayee, M.M. Murphy, J.L. Ellenberger, National Institute for Occupational Safety and Health, USA

387 Optimising stope design and ground support – a case study
R.M. Stephenson, M.P. Sandy, AMC Consultants Pty Ltd, Australia

401 Rock support in the Kiirunavaara Mine
L. Jacobsson, J. Töyrä, B. Woldemedhin, H. Krekula, Luossavaara–Kiirunavaara AB, Sweden

411 Selecting support for new mine development – a case study from Impala Platinum Ltd
L.J. Gardner, M.H. Fox, N.L. Conley, Impala Platinum Ltd, South Africa

421 Guidelines for the design and construction of underground portals in open pits – a case study of the Gateway Mine
J.H. Graaf, Golder Associates Pty Ltd, Australia; T. Parrott, Consolidated Minerals, Australia

437 Geotechnical analysis and ground support selection for the Ernest Henry crusher chamber
A.D. Campbell, Xstrata Copper, Australia; C.R. Lilley, Beck Engineering Pty Ltd, Australia; S. Waters, P.A. Jones, Xstrata Copper, Australia

451 Redevelopment support at Northparkes Mines
P. Brenchley, L.A. Snyman, J. Samosir, B. Coxon, Rio Tinto, Australia

461 Loading capacity of yielding connections used in steel arch roadway supports
P. Horyl, VSB-Technical University of Ostrava, Czech Republic; R. Snuparek, Institute of Geonics, Czech Republic; M. Hlavackova, VSB-Technical University of Ostrava, Czech Republic

Corrosion

473 Metallurgical examination of rockbolts failed in service due to stress corrosion cracking
E. Elias, D. Vandermaat, University of New South Wales, Australia; P. Craig, Jennmar Australia Pty Ltd, and University of New South Wales, Australia; H. Chen, A. Crosky, S. Saydam, P. Hagan, B. Hebblewhite, University of New South Wales, Australia

485 Emerging technologies in corrosion protection and acid resistance for ground support elements
D.W. Evans, Dywidag Systems International Pty Ltd, Australia

497 Corrosion considerations in the design and operation of rock support systems
J.F. Dorion, Niobec Inc., Canada; J. Hadjigeorgiou, Lassonde Institute of Mining, University of Toronto, Canada

Numerical modelling

513 Numerical modelling and rock support design in Codelco's New Mine Level panel caving project
J.A. Jarufe, Codelco, Chile, and The University of Western Australia, Australia; P. Vasquez, Codelco, Chile

525 Dynamic simulations of excavations with yielding bolts
C.R. Lilley, Beck Engineering Pty Ltd, Australia; T. Roberts, Jennmar Australia Pty Ltd, Australia; G. Putzar, Beck Engineering Pty Ltd, Germany; D.A. Beck, Beck Engineering Pty Ltd, Australia

539 Analysis of extraction level performance at the Henderson Mine
D.P. Sainsbury, Itasca Australia Pty Ltd, Australia; D.M. Loring, formerly of Freeport-McMoRan Copper and Gold Inc., USA

551 Ground support design under highly stressed conditions
A. Vakili, M.P. Sandy, AMC Consultants Pty Ltd, Australia; M. Mathews, B. Rodda, Cobar Management Pty Ltd, Australia

565 Numerical back-analysis of simulated rockburst field tests by using coupled numerical technique
P. Zhang, C.P. Yi, E. Nordlund, S. Shirzadegan, U. Nyberg, Luleå University of Technology, Sweden; L. Malmgren, A. Nordqvist, Luossavaara–Kiirunavaara AB, Sweden

Shotcrete

585 Durability performance of bi-component polymer fibres under creep and in aggressive environments
J. Kaufmann, Empa, Switzerland; M. Manser, Brugg Contec AG, Switzerland

597 A rapid method for highlighting shotcrete performance issues in underground mines
J.P. Doolan, I.R. Hulls, Mining One Pty Ltd, Australia

609 Evaluation of Australian cement reactivity in accelerated shotcrete
G. Boon, D. Kunasagaram, Sika Australia, Australia

617 Advances in shotcrete nozzle operator training
A.J. Loncaric, Stratacrete Pty Ltd, Australia; E. Goransson, Edvirt AB, Sweden; U. Singh, Stratacrete Pty Ltd, Australia

629 Practical improvements to the shotcreting process at Lisheen Mine with particular attention to the mix design and admixture usage
J.F. Talbot, J. Burke, Vedanta Resources Lisheen Mine, Ireland

Instrumentation

645 Onsite visualisation of measured information in mining engineering for advanced risk management
S. Akutagawa, Kobe University, Japan; S. Komiyama, Toa Elemes, Japan; T. Kunimi, Akebono Brake Industry, Japan; A. Takahashi, Kankyo Sogo Technos, Japan; C. Izumi, Oriental Consultants, Vietnam; R. Abe, Oriental Consultants, India

657 Visualisation of deformation or force in rock supporting structures
A. Nishio, H. Zhang, S. Akutagawa, Kobe University, Japan; K. Takeya, SEC Corporation, Japan; Y. Ishizuka, Hokuto Denshi Kogyo, Japan; T. Katayama, Kankyo Sogo Technos, Japan

667 Quality improvement of rockbolting
Y. Yokota, T. Yamamoto, K. Date, T. Mori, Technical Research Institute, Kajima Corporation, Japan

681 Author Index