

## Table of Contents

Australian Centre for Geomechanics.....	iii
Committees .....	v
Technical Reviewers.....	ix
Preface.....	xi

### Plenary Sessions

#### Keynote Address

Post-Mining Landforms – Engineering a Biological System.....	3
<b>A.B. Fourie, M. Tibbett</b>	
Global Review and Cost Comparison of Conventional and Phyto-Technologies for Mine Closure .....	13
<b>I.M. Weiersbye</b>	
Ageing Effects in Seismic Behaviour of Closed Tailings Deposits .....	31
<b>J.H. Troncoso, E. Garcés</b>	
Experience of Canadian Partnership Programs – MEND and NOAMI.....	43
<b>G. Tremblay, C. Hogan</b>	
The El Indio Mine Closure – A Significant Environmental Accomplishment .....	53
<b>M. Robledo, J. Meyer</b>	

### Legal and Regulatory Requirements

Mine Closure – A Regulators Guide to the Things that Matter .....	69
<b>D.R. Welsh</b>	
Mine Closure – Legal, Social and Environmental Aspects in Brazil .....	79
<b>J.C.C. Flores, H.M. Lima, H. Herrmann</b>	
South African Legislation Pertinent to Gold Mine Closure and Residual Risk.....	89
<b>M.W. Sutton, I.M. Weiersbye</b>	
Western Australian Regulatory Approach to Mining Approvals and Mine Closure .....	103
<b>G. Cobby</b>	
The Role of the Golden Gecko Awards in Enhancing Mine Closure.....	107
<b>D. Risbey, G. Cobby</b>	
Abandoned Mines in Peru – Prioritization of Environmental Remediation.....	111
<b>M.G. Rankin, A. Almenara, A. Rodriguez, G.A. Tremblay</b>	

### Social Issues

Social Issues Related to the Closures of Underground Coal Mines in the Czech Republic .....	123
<b>J. Dvořáček</b>	
Influence of Socio-Environmental Factors on Future Closure Plans.....	129
<b>M. Weber, W. Brandt</b>	
Getting Social Impact Assessment Right – Minimising Project Risk and Maximising Sustainable Outcomes.....	139
<b>K. Ferguson</b>	
Vandals or Entrepreneurs? Acknowledging and Managing the Human Factor During Mine Closure in the Developing World Context.....	145
<b>M.T. Reichardt, C.L. Reichardt</b>	

### Criteria for Closure

Developing Completion Criteria for Alcoa’s Bauxite Mine Rehabilitation in Western Australia – An Iterative Process .....	155
<b>C.D. Grant</b>	

A Risk Assessment Approach for Comparing Mine Rehabilitation and Closure Options at Coal Mines in Central Queensland, Australia .....	167
<b>D. Welsh, A. Bianco, P. Roe</b>	
MRPP – The French Prevention Procedure to Manage Post-Mining Hazards .....	179
<b>C. Didier, X. Daupley</b>	
Development of Mine Site Close-Out Criteria for Arsenic and Lead Using a Health Risk Approach.....	191
<b>V. Diacomanolis, J.C. Ng, B.N. Noller</b>	
Closure – The Most Tangible Indicator of Sustainable Development for the Mining Industry; Rio Tinto's Approach.....	199
<b>M.C. Moller, R. Flugge, S. Anstee</b>	
Mine Closure Management Guidelines for Codelco .....	207
<b>I. Marshall, M.F. Dominguez</b>	
Completion Criteria for Rehabilitated Forest Ecosystems on Mined Land – Should They be Based on Unmined Reference Sites? .....	211
<b>P.D. Erskine, D.R. Mulligan, M.F. Olsen, B. Kirsch, P. Roe</b>	
Mine Life Cycle Systems Models and Integrated Mine Closure for Sustainability .....	217
<b>D.J.A. van Zyl, M. Scoble, G.W. Wilson</b>	
Mine Closure Risk and Decision Analysis.....	225
<b>R.B. Logan, D.P. Murphy, C.A. Beale</b>	

### **Mine Closure Planning**

Revitalisation of the Allotment of Underground Mine below the Ground and on the Surface – Application to the Jan Sverma Mine in Zacler, Czech Republic .....	237
<b>Z. Adamec, K. Novotný, I. Rakouš, T. Tisovský, J. Votoček, V. Slivka, V. Petroš</b>	
GIS-Based 3-D Analysis and Visualisation Tools – An Example in Advanced Planning for Mine Closure, Hunter Valley, Australia .....	247
<b>M. Andrews, A. McMullen, S. Grimshaw</b>	
Methodology for the Strategic Assessment of Mine Closure Options .....	253
<b>S.A.P. Brown, B. Randell</b>	
Reconstituted Soils – A Probabilistic Approach to Resolve Aspects Relating to the Sustainability and Economic Viability of the Rehabilitation of Mined Lands.....	261
<b>R. Hattingh, H. Kotze, C. Linstrom, R. Krantz, C. Viljoen, N. Jovanovic</b>	
Ferrous Mine Closure Planning in Caroni Basin, Venezuela .....	273
<b>Y.A. Blanco, A.J. Castillo, Z. Andara</b>	
Strategies and Technologies for Early Mine Closure Planning.....	283
<b>K.J. Lang, J.W. Rowe, B.C. Johnson, J. Harrington, R. McKittrick</b>	
Planning for Closure as Part of Project Approval .....	289
<b>S. Grimshaw</b>	
Closure Planning and Implementation at CVRD Inco's Whistle Mine, Ontario, Canada .....	301
<b>B. Ayres, M. O'Kane, L. Lanteigne, Q. Smith</b>	
Methodological Proposal to Incorporate the Environmental Dimension in the Development of Conceptual Mine Closure Plans .....	313
<b>M. Quiroz</b>	
GIS – A Tool to Plan and Update Mine Closure Planning .....	325
<b>K. Leal, K. Viveros, P. Paolini</b>	
Challenges for Codelco, Salvador Division, in the Development of a Closure Plan and Productive Reconversion Project .....	335
<b>J. Cifuentes, E. Ortiz, R. Adaros, M. Flores, C. Wulff, E. Acuña, M. Nehme, M. Cabezas, E. Solar</b>	

## Costs and Financing

Demolition – The Forgotten Closure Strategy .....	347
<b>D.P. Murphy, G. Duff, R.C. Marshall</b>	
Incorporation of the Environmental Costs in Open Pit Mine Design for Closure .....	357
<b>G.D. Ramírez-Rodríguez, T.G. Rozgonyi</b>	
Progressive Reduction of Liabilities and Recovery of Financial Sureties in Recognition of Successful Rehabilitation in Western Australia.....	365
<b>S. Mackenzie, D. Jasper, H.W.B. Lacy, B. Bow</b>	
Mine Closure Process of Polish Hard Coal Mines – Structure and Estimation of Costs of Decommissioning .....	375
<b>J. Jarosz</b>	
Costs of Mine Closure – Learning from the Past.....	383
<b>L. Wilde</b>	
A New Model for Estimation of Mine Closure Costs .....	393
<b>A. Peralta-Romero, K. Dagdelen</b>	

## Mine Site Reclamation and Rehabilitation

Bioremediation of Diesel Fuel-Contaminated Desert Mining Soils in the Atacama Desert (Chile) – A Tool for Environmental Management.....	407
<b>A. Godoy-Faúndez, B. Antizar-Lalislao, L. Reyes-Bozo, C. Sáez-Navarrete, A. Camaño-Moreno</b>	
Mine Closure – The State-of-the-Art in Minas Gerais, Brazil .....	413
<b>H.M. Lima, M.F. Cunha, D. Barcellos</b>	
Coordinating Research and Practice in Oil Sands Mine Reclamation.....	425
<b>V.R. Wilson, J.R. Gulley, H.B. Anderson, W. Tedder</b>	
Beating the Budget – Case Study of Closure of Rietspruit Mine, South Africa .....	431
<b>C.A. van Renssen</b>	

## Revegetation and Phytostabilisation

Sustainable Revegetation of Arsenic-Rich Gold Mine Tailings in the Victorian Goldfields, Australia – Using High Value Eucalyptus Trees and Indigenous Grasses.....	443
<b>A.I. Doronila, A.J.M. Baker, R.J. Watkins</b>	
Effect of Amendment C:N Ratio on Plant Diversity, Cover and Metal Content for Pb and Zn Mine Tailings in Leadville, Colorado, USA.....	453
<b>S. Brown, C. Henry, P. DeVolder</b>	
Generating Carbon Credits through Mine Site Restoration with Organic Amendments .....	459
<b>S. Brown, S. Subler</b>	
Sustainable Rehabilitation of Copper/Gold Mine Tailings in Chile through Phytostabilisation – More than Plants.....	465
<b>R. Ginocchio, C. Santibáñez, P. León-Lobos, S. Brown, A.J.M. Baker</b>	
The Importance of Microbial Activity for Sustainable Rehabilitation of Copper Mine Tailings .....	475
<b>C. Santibáñez, J.L. Romero, A. Arochas, P. Medina, R. Ginocchio</b>	
The Engineering Contribution of Vegetation to the Stability of Cover Systems.....	483
<b>A.B. Fourie</b>	
Reforestation of Areas Degraded by Informal Sector Mining in Madre de Dios Forest, Peru .....	495
<b>J.A. Vidalón</b>	

## Water and Acid Water Management

Utilisation of Mine Waters from Closed and Flooded Underground Uranium Mines as a Secondary Source of Uranium .....	509
<b>B. Michálek, A. Hájek, N. Rapantová, A. Grmela</b>	
Strategies for Reducing Seepage from Surface Waste Rock Piles During Operation and Post-Closure.....	521
<b>D.J. Williams, T.K. Rohde</b>	
Strategies for Reducing Seepage from Surface Tailings Storage Facilities during Operation and Post-Closure.....	533
<b>D.J. Williams</b>	
Rehabilitation of Lake Yanamate, Cerro De Pasco, Peru .....	543
<b>J.A. Vidalón, G. Dalla Porta</b>	
Water Treatment and Management during the Closure of the Colomac Mine .....	553
<b>J.T. Chapman, W. Coedy, S. Schultz, M. Rykaart</b>	
Copper Heap Leaching Operations – Understanding and Managing the Processes to Reduce Long-Term Environmental Liabilities .....	565
<b>S. Rivera, A. Ramirez, P. Pinto, J. Rosales, C. Gonzalez</b>	
Handling of Copper Leachate Produced after the Cessation of Mining Operations.....	571
<b>R.E. Dixon, C.A. García, I.D. Ewart</b>	
Natural Attenuation as a Method of Effluent Management for Closed Mine Facilities.....	577
<b>J. McCartney, J. Chahbandour, G. Beale</b>	
Adaptive Remediation of a Fine-Grained Borrow Pit in Canada’s North .....	583
<b>J. Cassie, G. Claypool, E. Pike</b>	
Emergency Treatment of Acid Mine Drainage at the Leviathan Mine with the Rotating Cylinder Treatment System .....	593
<b>T.K. Tsukamoto, F. Vasquez</b>	
Morro do Ouro Pit Lake Water Quality Prediction.....	603
<b>J.A.M. Esper, R.D. Amaral, D. Banton, R. Verburg</b>	
Current Trends in Heap Leach Facility Closure in Nevada – Emphasis on Draindown .....	613
<b>R.J. Frechette</b>	
Achieving Mine Closure and Lease Surrender in North Queensland, Australia – A Case Study.....	619
<b>J. Grounds, T. Payne, W.J. Haylock</b>	

## Mine Waste Management and Cover Design

Cover System Design and Testing for Pierina Mine, Ancash, Peru .....	633
<b>G. Zhan, W. Baumann, M.A. Milczarek, T-M. Yao, R.C. Rice</b>	
Impacts of Vegetation on Soil Cover Performance .....	645
<b>B.E. Wickland, J. Hull, E. Pike, G.W. Wilson</b>	
Geotechnical Materials and Wood Wastes for Embankment Stabilisation of Tailing Storage Facilities .....	655
<b>T. Worthington, M.F. Braimbridge, S. Vlahos, N. Amoah, M. Tibbett</b>	
Practical Considerations for Choosing Covers for Suphidic Tailings Areas .....	665
<b>K.A. Bocking, K.J. DeVos, M. Butler</b>	
Assessing Cover System Performance – A Hillslope Hydrology Approach .....	673
<b>J.J. McDonnell, L. Hopp, A. Mazurkiewicz, D. Penna, P. Condon, M. O’Kane</b>	
Evaporation and the Water Balance for Sloped Covers on Mining Wastes.....	683
<b>B. Weeks, G.W. Wilson</b>	
Results after One Year Monitoring of a Field-Scale Experiment for Evaluating the Performance of Covers Constructed of Paste Rock Material in Copper Cliff, Ontario, Canada .....	689
<b>J. Miskolczi, G.W. Wilson</b>	

Waste Rock Backfill of Open Pits – Design, Optimisation and Modelling Considerations.....	701
<b>B.C. Johnson, K.C. Carroll</b>	

Closure Designs for the Bajo de Alumbra Mine, Argentina – Evaluation of Store and Release Test Plot Cover System Designs in an Arid Environment .....	709
<b>M. O’Kane, D. Christensen, G. Vasques</b>	

### **Closure under Extreme Environmental Conditions**

Selbaie Mine Closure Plan for the Long Term .....	725
<b>D. Caron, D. Adam, M. Wiber</b>	

Mine Closure in the Arctic.....	735
<b>S.P. Reshetnyak, Y.V. Fedotova</b>	

Reclamation of Frozen, Sulphidic Tailings Area – Nanisivik Mine, Northern Canada.....	743
<b>G. Claypool, J. Cassie, R. Carreau</b>	

Closure of Nanisivik Mine in the Canadian Arctic – Progress and Costs.....	755
<b>R. Carreau, M. Markle, J. Cassie, G. Claypool</b>	

Tailings Facility Closure in Arid Environments – Research and Outcomes, a Review of Sites Closed Through this Process in Western Australia’s Arid Regions.....	767
<b>H.W.B. Lacy, K.L. Barnes</b>	

Abandoned Mines in Northern Canada – Programme Challenges and Case Studies.....	777
<b>M. Nahir, C. David</b>	

### **Monitoring**

Assessing Rehabilitation Success in Semi-Arid, Unpredictable Environments – Implications for Completion Criteria .....	789
<b>O.G. Nichols, C. Latham</b>	

A Post Closure Evaluation of the Accuracy of Water Quality Predictions of Spent Ore Leachate Chemistry.....	803
<b>S.C. Shaw</b>	

Detail Assessment of Metal Distribution in Polluted Soil – South African Case Study.....	815
<b>J.H. van der Waals, R. Erdmann, C. van der Merwe</b>	

Developing a Quantitative Framework to Assess the Success of Mine Site Rehabilitation.....	821
<b>M. Edraki, T. Baumgartl, B.N. Noller</b>	

Determination of Trace-Element Associations in Neutralisation Sludges Using High Resolution Microscopy – Implications for the Chemical Stability of Sludge .....	829
<b>D.B. Loomer, D.H. Flather, T.A. Al</b>	

Instrumentation with Fiber Optic Sensors Emphasising Operation and Closure of Tailings Dams.....	839
<b>C. Fahrenkrog</b>	

An Overview of Revegetation Assessment in Mining Sites Using Advanced Hyperspectral Techniques.....	847
<b>I.M. Alomía, V. Torres, J.C. Carrasco, R. Hernández, M. Sánchez</b>	

Determination of Heavy Metals Bioavailability in Soils and Mining Wastes .....	859
<b>M. Almendras, M. Carballa, R. Chamy, L. Diels, K. Vanbroekhoven</b>	

### **Mining Heritage and Tourism**

Medieval Salt Mine – A Modern Tourist Attraction with an Ancient History.....	869
<b>R.S. Popielak, K. Zięba</b>	

Authors Index.....	879
--------------------	-----