

American Rock Mechanics Association

41st US Rock Mechanics Symposium

Golden Rocks 2006

“50 Years of Rock Mechanics”

June 17 – 21, 2006
Golden, Colorado, USA

Volume 1 of 3

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571
www.proceedings.com

ISBN: 978-1-60423-622-4

Some format issues inherent in the e-media version may also appear in this print version.

American Rock Mechanics Association
41st US Rock Mechanics Symposium
2006

TABLE OF CONTENTS

VOLUME 1

Some Thoughts about Mining, Rock Mechanics, and Butterflies.....	1
<i>William Hustrulid</i>	
50 Years of Rock Mechanics Research (1955-2005): the Effect on Safety in U.S.	
Underground Mines	2
<i>Mike Jenkins</i>	
996:Testing and Evaluation of Corrosion on Cable Bolt Anchors.....	16
<i>Rhett Hassell</i>	
944:A Methodology for Selection of Fully Encapsulated Resin Grouted Bolts.....	27
<i>Alan Thompson</i>	
938:Evaluation of Ground Support Requirements for D Orebody LHD Block,	
Molycorp	34
<i>Bo Yu</i>	
942:Energy Absorption of Shotcrete and Reinforcement Schemes.....	44
<i>Alan Thompson</i>	
991:Using Foaming Grout to Stabilize a Ventilation Raise in Very Poor Rock.....	56
<i>John Magyar</i>	
1050:Extraction of a Remnant Sill Pillar Under Challenging Ground Conditions at	
the Stillwater Mine, Nye, Mt.....	63
<i>Radford Langston</i>	
1084:Increasing Service Life of Muck Passes at the East Boulder Mine	74
<i>Eric Smith</i>	
1120:Stable Pillar Spans at Tau Lekoa Mine	83
<i>Michael Dunn</i>	
Slope Stability	93
<i>Peter Stacey</i>	
960:Feasibility Level Geological and Geotechnical Investigation for Union Park	
Dam.....	95
<i>Horst Uebelacker</i>	
998:Field Verification of a Geostatistical Method for Simulating Fracture Network	
Models.....	123
<i>Mohan Srivastava</i>	
1046:Screening Level Characterization of Rock Structure in Dam Foundations	
Derived from Historic Construction Photographs.....	131
<i>Todd Loar</i>	

1071:Ground Deformation and Structure Stability in Highly Stressed Rock Formations.....	139
<i>Paul Headland</i>	
1051:Acquisition and Assessment of Geometric Rock Mass Features by True 3D Images.....	155
<i>Andreas Gaich</i>	
957:Spatial Relationships Between Discontinuity Orientation and Rock Mass Behaviour in Underground Excavations	165
<i>Edward Button</i>	
1097:Design and Construction of a Large Span Underground Opening with Low Cover in Weak Rock, Napa, California.....	176
<i>Johannes Van Greunen</i>	
1141:Analysis of the Stability Condition of Underground Excavations by Experimental Measurements and 3D Numerical Modelling.....	188
<i>A. M. Ferrero</i>	
Petroleum Geomechanics.....	N/A*
<i>Jean-Claude Roegiers</i>	
922:Wellbore Stability with Consideration of Pore Pressure and Drilling Fluid Interactions	199
<i>Jincai Zhang</i>	
939:Calibration of Distinct Element Models for the Cooper Basin, Australia - Towards Improved Hydrocarbon Production	209
<i>Cameron Morelli</i>	
986:InSAR Application in Detection of Oilfield Subsidence on Alaska North Slope	219
<i>W. Zhou</i>	
1153:Monitoring a Propagating Front: Exploiting Fresnel Precursors from Fractures.....	230
<i>L. J. Pyrak-Nolte</i>	
919:Hydromechanical Simulaiton of Naturally Fractured Reservoirs	238
<i>L. Jeannin</i>	
1028:Mandel-Cryer Effect for Non-perfectly Rigid Motion.....	249
<i>Imsoo Lee</i>	
1030:The Failure Mechanism Around Horizontal Boreholes Excavated in Sedimentary Rocks.....	258
<i>Omer Aydan</i>	
1128:Numerical Simulation of Coupled Thermo-hydro-chemo-mechanical Processes Through the Linking of Hydrothermal and Solid Mechanics Codes	268
<i>Andrea Segalini</i>	
Numerical Modeling	277
<i>John Curran</i>	
989:Measurements of Plutonic Rock Elastic Properties Utilizing Ultrasonic Waves	278
<i>Hui Li</i>	
1048:Sensitivity of Elastic Wave Velocities to Reservoir Stress Changes Caused by Production	288
<i>Colin Sayers</i>	
1067: The Effect of Stress Path on the Sonic Response of Pierre Shale.....	295
<i>John Dudley</i>	

1070:Modeling the Stress Dependence of Elastic Wave Velocities in Soft Rocks.....	301
<i>Erling Fjaer</i>	
1029:Hybrid Discrete Fracture Network and Equivalent Continuum Model for Shaft Sinking	309
<i>William Dershowitz</i>	
1040:Computational Aspects of Shallow Depth Pillar Layout Design Problems in Tabular Mining.....	315
<i>John Napier</i>	
1023:A Numerical Modeling Attempt of Failure in Jointed Rock Masses by Kink Zone Instability.....	326
<i>Jean-Francois Noel</i>	
968:UDEC Simulation of Triaxial Testing of Lithophysal Tuff.....	338
<i>Mark Christianson</i>	
Rock Mechanics; 1956-2006 - How Far Have We Really Advanced?.....	346
<i>Charles Fairhurst</i>	
931:Caving, Load Transfer and Mine Design in Western US Mines	347
<i>Hamid Maleki</i>	
935:Development of Ground Response Curves for Longwall Tailgate Support Design	357
<i>Essie Esterhuizen</i>	
1119:Numerical Modeling Procedures for Practical Coal Mine Design.....	367
<i>Karl Zipf</i>	
1154:Seam-specific Pillar Strength Formulae for South African Collieries.....	378
<i>Alan Thompson</i>	
1129:Considerations Associated with the Application of the UNSW and Other Pillar Design Formulae.....	391
<i>Jim Galvin</i>	
932:Subsidence Characteristics at Bowie Mines, Colorado.....	400
<i>Hamid Maleki</i>	
908:The Degradation of a Simulated Ballast Bed and the Effectiveness of Track Maintenance Techniques	410
<i>Sebastian Lobo-Guerrero</i>	
994:Excavatability of Lunar and Martian Regolith: Initial Laboratory Tests on JSC-1 Simulants	422
<i>Leslie Gertsch</i>	
1082:The Mechanics of Indentation of Rock – A Critical Review	432
<i>Yousof Abd Al-Jalil</i>	
1118:Dynamic Fragmentation of Rock by High-voltage Pulses.....	450
<i>Sang Ho Cho</i>	
1146:Numerical Simulation of Disc Cutter Behavior in Bimrocks	460
<i>Cheowchan Leelasukseree</i>	
1165:Neural Networks Analysis for Estimating Rock Cuttability from Rock Properties	469
<i>Nuh Bilgin</i>	
923:The Initiation of Slip on Frictional Fractures	478
<i>Antonio Bobet</i>	

966:Investigation of the Compaction Localization Process in High-porosity, Fluid-saturated Sandstone Using Acoustic Emission Focal Mechanisms	487
<i>Glen Gettemy</i>	
930:Crack Coalescence in Brittle Material Under Cyclic Loading	497
<i>Tae Young Ko</i>	
1098:Influence of the Intermediate Principal Stress on Compaction Localization Conditions	506
<i>Kathleen Issen</i>	
1064:A New Geomechanical Tool for the Evaluation of Hydrocarbon Trap Integrity.....	513
<i>Suzanne Hunt</i>	
1088:Stability Analysis of Fractured Rock Mass Excavations in Ornamental Stone Quarries by Means of 3D Numerical Modelling.	523
<i>Andrea Segalini</i>	
915:Cosserat Medium Constitutive Model for Laminated Salt Rock and Numerical Analysis for Stability of Cavern in Deep Beded Salt Rock Formations	534
<i>Chunhe Yang</i>	
1069:Embedded Discontinuity Finite Element Modeling of Three-dimensional Strong Discontinuities in Rocks.....	545
<i>Richard Regueiro</i>	
965:Numerical Simulation of Size Effect in Rock	557
<i>Ahmadali Fakhimi</i>	
963:Numerical Models of Macroporous Rock: Quantifying the Influence of Void Characteristics on Elastic Modulus	565
<i>Bethany Erfourth</i>	
1077:Arithmetic Study on Cellular Automata Model for Evolution Process in Deep Mining Rock Mass Deformation	575
<i>Yang Peng</i>	
1065:Meshfree Modelling of Elastic Rock Material Using a Generalized Formulation	583
<i>Sebastian Skatulla</i>	
1161:Application of Mine Seismicity Monitoring Technology in Mitigating Geotechnical Risks at Barrick's Darlot Gold Mine	595
<i>Dianmin Chen</i>	
1163:Using Seismic Data for Rockburst Re-Entry Protocol at INCO's Copper Cliff North Mine	606
<i>Ian Leslie</i>	
1164:Seismic Energy Scaling for Mine Induced Microseismicity	616
<i>Cezar Trifu</i>	
1168:A Study of Mine Stability Using Records of Ground Tilting	624
<i>Steve Spottiswoode</i>	
990:A Continuous Tunnel Monitoring System for Both Construction and Service Stages	636
<i>Carlos Gama</i>	
1018:Volumetric Characterization of the Ground Using Seismic Velocity Tomography and Single-Hole Reflector Tracing	642
<i>Joe Descour</i>	

1019: Imaging Changing Ground in Front and Above a TBM Using Seismic Reflector Tracing; A Case Study	652
<i>Takaji Yamamoto</i>	
1039: Utilizing Ground Penetrating Radar Technology for Detection and Delineation of Geologic Anomalies that may Lead to Massive Hanging Wall Failure.....	662
<i>Andre Opperman, Jan Delange</i>	
1102: Innovative Digital Instrumentation Methodologies for Geotechnical Monitoring.....	669
<i>Andrew Hyett</i>	

VOLUME 2

960: Feasibility Level Geological and Geotechnical Investigation for Union Park Dam.....	678
<i>Horst Uebelacker</i>	
998: Field Verification of a Geostatistical Method for Simulating Fracture Network Models.....	706
<i>Mohan Srivastava</i>	
1046: Screening Level Characterization of Rock Structure in Dam Foundations Derived from Historic Construction Photographs.....	714
<i>Todd Loar</i>	
1071: Ground Deformation and Structure Stability in Highly Stressed Rock Formations.....	722
<i>Paul Headland</i>	
1051: Acquisition and Assessment of Geometric Rock Mass Features by True 3D Images	738
<i>Andreas Gaich</i>	
957: Spatial Relationships Between Discontinuity Orientation and Rock Mass Behaviour in Underground Excavations	748
<i>Edward Button</i>	
1097: Design and Construction of a Large Span Underground Opening with Low Cover in Weak Rock, Napa, California.....	759
<i>Johannes Van Greunen</i>	
1141: Analysis of the Stability Condition of Underground Excavations by Experimental Measurements and 3D Numerical Modelling.....	771
<i>Andrea Segalini</i>	
922: Wellbore Stability with Consideration of Pore Pressure and Drilling Fluid Interactions	782
<i>Jincui Zhang</i>	
939: Calibration of Distinct Element Models for the Cooper Basin, Australia - Towards Improved Hydrocarbon Production	792
<i>Cameron Morelli</i>	
986: InSAR Application in Detection of Oilfield Subsidence on Alaska North Slope	802
<i>Gang Chen</i>	

1153:Monitoring a Propagating Front: Exploiting Fresnel Precursors from Fractures.....	813
<i>Laura Pyrak-Nolte</i>	
919:Hydromechanical Simulaiton of Naturally Fractured Reservoirs	821
<i>Laurent Jeannin</i>	
1028:Mandel-Cryer Effect for Non-perfectly Rigid Motion.....	832
<i>Imsoo Lee</i>	
1030:The Failure Mechanism Around Horizontal Boreholes Excavated in Sedimentary Rocks	841
<i>Omer Aydan</i>	
1128:Numerical Simulation of Coupled Thermo-hydro-chemo-mechanical Processes Through the Linking of Hydrothermal and Solid Mechanics Codes	851
<i>Andrea Segalini</i>	
989:Measurements of Plutonic Rock Elastic Properties Utilizing Ultrasonic Waves	860
<i>Hui Li</i>	
1048:Sensitivity of Elastic Wave Velocities to Reservoir Stress Changes Caused by Production	870
<i>Colin Sayers</i>	
1067:The Effect of Stress Path on the Sonic Response of Pierre Shale.....	877
<i>John Dudley</i>	
1070:Modeling the Stress Dependence of Elastic Wave Velocities in Soft Rocks.....	883
<i>Erling Fjaer</i>	
1029:Hybrid Discrete Fracture Network and Equivalent Continuum Model for Shaft Sinking	891
<i>William Dershowitz</i>	
1040:Computational Aspects of Shallow Depth Pillar Layout Design Problems in Tabular Mining.....	897
<i>John Napier</i>	
1023:A Numerical Modeling Attempt of Failure in Jointed Rock Masses by Kink Zone Instability	908
<i>Jean-Francois Noel</i>	
968:UDEC Simulation of Triaxial Testing of Lithophysal Tuff.....	920
<i>Mark Christianson</i>	
Rock 50 Years of Rock Engineering - Developments and Deficiencies.....	928
<i>Evert Hoek</i>	
1005:Thin, Spray-On Lining Applications for Rockburst, Blast and Fire Damage Mitigation	930
<i>James Archibald</i>	
1036:Yielding Reinforcement Elements in Rock Bolting Technology.....	942
<i>Wolfgang Dolsak</i>	
1090:The Relationship Between the Performance of Grout Packs Tested Underground and in a Laboratory Press	950
<i>Mark Grave</i>	
1140:The Development of a High Strength Thin Support Liner and Two Case Studies	960
<i>Sam Spearing</i>	

1024:Seismic Monitoring Applications at Falconbridge's Craig and Onaping Mines	969
<i>Brad Simser</i>	
1041:Monitoring of Rock Mass Behaviour As a Design and Hazard Assessment Tool in Underground Stopes	982
<i>Francois Malan</i>	
1159:High Resolution Seismic Monitoring at Mt Keith Open Pit Mine	993
<i>Cezar Trifu</i>	
987:Current Technology to Predict Scour of Rock	999
<i>George W. Annandale</i>	
1085:U.S. Highway 6: Clear Creek Canyon Rockslide and Remediation	1010
<i>Kent Pease</i>	
1127:Influence of Cross Jointing on Block Slump Stability	1018
<i>Scott Kieffer</i>	
1145:Slope Stepping Decision Using a Quantified Risk Assessment: Chuquicamata Case.....	1024
<i>Alex Calderon</i>	
972:Capacity of Foundations on Discontinuous Rock	1032
<i>Fred Kulhawy</i>	
1052:Probabilistic Slope and Tunnel Block Stability Analysis Using Realistic Fracture Network Models	1039
<i>Karen Moffitt</i>	
1100:Slope Monitoring and Failure Mitigation Techniques Applied in the Gold Quarry Open Pit.....	1047
<i>Russell Sheets</i>	
1176:Assessment of Wedge Stability Along Highway Cuts	1060
<i>John Hadjigeorgiou</i>	
928:Mode II Subcritical Crack Growth Parameters for Sandstone	1070
<i>Tae Young Ko</i>	
1099:DEM Analysis of Subcritical Crack Growth: Effects of Diagenesis and Stress	1077
<i>Namsu Park</i>	
1130:Laboratory Experiments of Hydraulic Fracturing on Glass Plates Help Investigating Basic Conditions for Fracture Branching and Fracture Containment Along Interfaces.....	1087
<i>Roberto Suarez-Rivera</i>	
959:3-D Simulation of Large-scale Hydraulic Fracturing Tests	1094
<i>Mao Bai</i>	
1000:Geomechanical Properties of Rock Salt and Gas Storage Construction in Jintan, China.....	N/A
<i>Maurice Dusseault</i>	
912:Gas Storage and Operations in Single Bedded Salt Caverns: Stability Analyses	1100
<i>Gang Han</i>	
918:CO₂/N₂ Flow Behavior of Deep Coal-Gas Reservoirs	1110
<i>Kunal Singh</i>	

1021:Cyclic Injection Modeling of Cuttings Re-Injection.....	1119
<i>Mao Bai</i>	
936:Natural Rock Fracture Aperture Properties through Fractals.....	1130
<i>Pinnaduwa Kulatilake</i>	
899:Fracturing Behavior of Prismatic Specimens Containing Single Flaws	1142
<i>Louis N. Y. Wong</i>	
969:Determining Size and Shape of Fractures from Trace Data using a Differential Evolution Algorithm.....	1152
<i>Jeremy Decker</i>	
1026:Digital Ground-based Photogrammetry for Measuring Discontinuity Orientations in Steep Rock Exposures.....	1164
<i>Lisa Krosley</i>	
1058:A Complementarity Approach for Modeling Fractures with Cohesion and Friction.....	1177
<i>Ovunc Mutlu</i>	
1147:Analysis of Fracture Patterns Constrained by Suitable Geological Model	1186
<i>Fabrizio Piana</i>	
1079:Kinematical Analyses of Rock Blocks Supported by 3D Imaging.....	1198
<i>Markus Pötsch</i>	
926:The Field-Scale Rock Mechanics Laboratory: Estimation of Post-Peak Parameters and Behaviour of Fractured Rock Masses	1209
<i>William F. Bawden</i>	
1020:Plenary talk: Evaluating Rockburst Damage Potential in Underground Mining.....	1221
<i>Daniel Heal</i>	
974:Seismic Responses of Underground Excavations in Jointed Rock Mass	1233
<i>Sui-Min (Simon) Hsiung</i>	
1156:Microseismic Monitoring during Construction of Large Underground Oil Storage Caverns.....	1246
<i>Cezar Trifu</i>	
1160:Microseismic System and Rockbursts Activity at the Campbell Mine, Ontario, Canada	1251
<i>Jaime Delgado</i>	
1074:Engineering Characterization of Cemented Rock Fill.....	1262
<i>Richard McNearney</i>	
1103:Optimizing Backfill Design for Ground Support and Cost Saving	1268
<i>Nantha Nadarajah</i>	
1132:Effect of Backfill on Open Stope Design.....	1274
<i>R. Pakalnis</i>	
1068:Modeling of Geo-dynamical Processes in Bedded Hard Rock - Saltrock Mass Surrounding the Deep Glogow Commercial Copper Ore Reserves in Poland	1285
<i>Witold Pytel</i>	
1162:Plenary talk: Comprehensive Geomechanical Design of a Large Underground Observatory At 6,800 Ft.....	1295
<i>Richard K. Brummer</i>	

992:Dam Failure by Rock Scour: Evaluation & Prevention (A Case Study)	1309
<i>Mike George</i>	
976:A Contribution to the Design of Tunnels Supported by a Pipe Roof	1317
<i>Günther Volkmann</i>	
980:Characterization of Block-forming Discontinuities During Primary Ore Caving at El Teniente Mine, Chile.	1329
<i>Alan Thompson</i>	
1076:I-70 Closure Near Idaho Springs Due to Multiple Rockslope Failures and the Subsequent Evaluation, Analysis, Mitigation, and Instrumentation of the Rockslope	1338
<i>Ben Arndt</i>	
1031:Cutting Joint Blocks and Finding Removable Blocks for General Joint Systems and General Free Rock Surfaces Using 3-D DDA	1345
<i>Gen-Hua Shi</i>	
1110:Shear Strength Model for Rock Joint and Its Applicability	1353
<i>Satoru Ohtsuka</i>	

VOLUME 3

1126:A Hybrid Approach to Modelling Blocky Rock Masses Using a Discrete Fracture Network and Finite / Discrete Element Combination	1363
<i>Robert Pine</i>	
1144:Comprehensive Hazard Identification in Rock Engineering Using Interaction Matrix Mechanism Pathways	1372
<i>John Harrison</i>	
1166:Plenary talk: Impact of Stress Anisotropy on Sand Cavity Strength: A Theoretical Analysis	1382
<i>Paul Van Den Hoek</i>	
906:An Integrated Modular Approach to Modeling Sand Production and Cavity Growth with Emphasis on the Multiphase and 3D Effects	1389
<i>Jin Wang</i>	
900:Compressive Strength and Acoustic Properties Changes in Shale with Exposure to Water-Based Fluids	1400
<i>Jianguo Zhang</i>	
964:Incorporating Thermochemoporoelastic Effects in Wellbore Stability Design in Shales	1412
<i>Ewerton Araújo</i>	
916:Optimization of Mud Properties for Drilling in Shale Using Coupled Chemo-poro-thermoelasticity	1424
<i>Qingfeng Tao</i>	
910:Analytic Solutions with Ionic Flow for a Pressure Transmission Test on Shale	1433
<i>Guizhong Chen</i>	
952:Fluid Flow in Measured Apertures of a Single Rock Fracture: A Depth Averaged Model and the Local Cubic Law Simulations	1442
<i>Prosper Mgaya</i>	

1054:Hydrologic Consequences of Gravity-induced Stresses Along a Ridge: Example from Annapolis Valley, Nova Scotia.....	1449
<i>William Savage</i>	
1158:Val Termine Cyclic Deformation Due to Seasonal Variation of Water Table	1459
<i>Mohamed El Tani</i>	
1049:Plenary talk: State and Origin of the Present-Day Stress Field in Sedimentary Basins: New Results from the World Stress Map Project.....	1467
<i>Mark Tingay</i>	
985:Using Breakouts for in Situ Stress Estimation in Tectonically Active Areas.....	1481
<i>Marcelo Frydman</i>	
1096:A Re-assessment of in Situ Stresses in the Canadian Shield	1494
<i>Peter Kaiser</i>	
1124:Interpolation/Extrapolation of Measured In Situ Earth Stresses: An Example from the Piceance Basin in Western Colorado.....	1503
<i>William A. Symington</i>	
1151:Constraints on in Situ Stress and Pore Pressure Using a Strength of Materials Approach.....	1515
<i>Daniel Moos</i>	
962:Lab Investigations of Percussion Drilling: from Single Impact to Full Scale Fluid Hammer	1524
<i>Gang Han</i>	
971:Tracking the Motion of a Prismatic Test Block with an Array of Laser Sensors	1532
<i>Dom Galic</i>	
1016:The Effects of Geometry on the Uniaxial Compressive Strength Properties of Intact Rock Core Specimens	1539
<i>A. Philip Dirige</i>	
1063:Brittle Failure of Rock-like Material Around an Opening Under Polyaxial Loading Condition	1549
<i>Seokwon Jeon</i>	
The Important Geological Influences on Rock Slopes, Tunnels, and Foundations in the Context of a Number of Case Histories	1555
<i>Richard Goodman</i>	
967:Use of Distinct Element Models to Investigate Collapse and Support of an Underground Opening as a Function of Varying Rock Mass Quality	1556
<i>Mary MacLaughlin</i>	
1035:The stress-strain behavior of in-stope pillars in the Bushveld Platinum deposits in South Africa.....	1568
<i>Bryan Watson</i>	
1037:Influence of Pillars Left on Overlying Merensky Reef When Mining on the Underlying UG2 Stopes.....	1577
<i>Navin Singh</i>	
914:Probabilistic Design of Hardrock Openings and Pillars	1589
<i>Scott Carlisle</i>	
993:The Use of LiDAR to Overcome Rock Slope Hazard Data Collection Challenges at Afternoon Creek, Washington.....	1597
<i>Alex Strouth</i>	

1104:A Virtual Environment for Visualizing Fractures During Tunneling.....	1607
<i>Jeremy Decker</i>	
1138:Advanced Techniques for Geo Structural Surveys in Modelling Fractured Rock Masses: Application to Two Alpine Sites	1619
<i>Iris Voyat</i>	
1142:Characterisation of Rock Slope Failure within Fault Zone Using Laser Scanning	1631
<i>Woon-Sang Yoon</i>	
1133:Insights from Laboratory Experiments on Simulated Faults with Application to Fracture Evolution in Geothermal Systems.....	1636
<i>Stephen Karner</i>	
1053:Poroelastic and Thermoelastic Effects of Injection into a Geothermal Reservoir.....	1646
<i>Andrew Nygren</i>	
1089:Long-term Evolution of the Transport Proprierties from the Coso Geothermal Reservoir.....	1654
<i>Igor Faoro</i>	
934:A Three-Dimensional Numerical Study of Fracture Slip Due to Cold Water Injection in Enhanced Geothermal Reservoirs	1660
<i>Ahmad Ghassemi</i>	
920:Time Dependent Evolution of the Excavation Damaged Zone Around Underground Openings for Radioactive Wastes Repositories	1666
<i>Frederic Pellet</i>	
929:WIPP Room Evolution and Performance Assessment Implications	1675
<i>Frank Hansen</i>	
1043:Geomechanical Analyses towards Optimization of Remote Handled Waste Capacity at the Waste Isolation Pilot Plant	1688
<i>Chris Francke</i>	
1170:WIPP Disposal Room Closure Calculations for Various Waste Inventories	1696
<i>Byoung-Yoon Park</i>	
904:Continuum Modeling of Masjed E Soleyman Power House Cavern Using an Empirical Continuum Media.....	1707
<i>Bagheri. M</i>	
911: Advance Rates of TBM Driving in Various Geological Conditions	1712
<i>Chikaosa Tanimoto</i>	
917: Hydraulic Fracturing Laboratory Test on a Rock with Artificial Discontinuities	1722
<i>Luis A. Casas</i>	
924:Numerical Simulation Evaluating the Structural Integrity of SPR Caverns in the Big Hill Salt Dome.....	1731
<i>B. Y. Park</i>	
937:Modified PTS Test and Clump Modeling on Mixed Mode Crack Growth in Granite.....	1743
<i>J. S. Lee</i>	
940:A Stabilized Finite Element Formulation For Materialand Geometric Nonlinearity in Computational Geomechanics	1753
<i>Xia Kaiming</i>	

943:How to Define a Magnitude of Loosening in Tunneling.....	1763
<i>Chikaosa Tanimoto</i>	
XXX:Feasibility Study of Applying SOFO Optical Fiber Sensor to Segment of Shield Tunnel.....	1774
<i>James C. Ni</i>	
953:Numerical Modeling of Rock Indentation andHeat Generation due to linear rock cutting.....	1782
<i>B. Mishra</i>	
956:Estimation of Mechanical Behavior of Soft RockUnder Low Confining Stress	1788
<i>Atsunori Tomita</i>	
961:A New 3D Stability Model for the Design of Non-Vertical Wellbores	1796
<i>Al-Ajmi A. M.</i>	
978:Stress Rate Dependent Strength of a Welded Tuffin Triaxial Tests	1811
<i>L. Ma</i>	
981:A Neuro-Fuzzy Approach for Prediction ofPoisson's Ratio and young's Modulus of Shale and Sandstone	1819
<i>Vasudev Singh</i>	
995:The Influence of Young's Modulus onNumerical Modelling Results	1826
<i>R. E. Hammah</i>	
1004:Simulation of Tectonic Deformation and Large-AreaCasing Shear Mechanisms---Part B: Geomechanics1	1831
<i>Hongxue Han</i>	
1012:Keynote Lecture: Seven Lessons of Geomechanics Software Development	1839
<i>J. H. Curran</i>	
1038:Remnant Mining in South African Gold Mines	1854
<i>N. Singh</i>	
1055:Proportional Errors of the Terzaghi Correction Factor.....	1867
<i>Wang Xiaoha</i>	
1056:Strength Characterization of a Weak Highly Fractured Shale	1873
<i>B. J. Murray</i>	
1062:Performance Estimation of TBM Disc Cutter by Linear Cutting Machine.....	1880
<i>Jeon Seokwon</i>	
1073:The Effect of Water Content on the Stiffness of a High Porosity Chalk.	1886
<i>M. L. Talesnick</i>	
XXX:Simulations of Underground Structures Subjected to Dynamic Loading using Combined FEM/DEM/SPH Analysis	1898
<i>J. P. Morris</i>	
1083:Dip Slope Characterization for Residential Development in Southern California using the Hoek-Brown Failure Criterion	1908
<i>B. R. Fisher</i>	
1087:Application of a design method coupling Block Theory and 3D DDA	1917
<i>M. R. Yeung</i>	
1092>New Wellbore Strengthening Method for Low Permeability Formations.....	1925
<i>Ivan R. Gil</i>	
1094:Disc Cutting of Low-Strength Brittle Rock.....	1931
<i>L. S. Gertsch</i>	

1101:Modeling Fluid Flow in Deformable FracturedReservoirs using Full Tensor Permeability.....	1938
<i>M. Bagheri</i>	
1122:Plastic Compaction in Diatomite: In Situ Stress versus Temperature Effects.....	1953
<i>B. R. Crawford</i>	
1125:DEM Analysis for Optimizing TBM Performance.....	1965
<i>T. Moon</i>	
1131:Geomechanics of Oil/gas Well Vicinity	1970
<i>V. N. Nikolaevskiy</i>	
1135:Acoustic Emission/Microseismic Source Location Analysis For a Limestone Mine Exhibiting High Horizontal Stresses.....	1980
<i>Hongliang Wang</i>	
1143:Analysis of Troubles in TBM Excavation and Estimation of Load on Support	1989
<i>N. Isago</i>	
1148:the Influence of Cave Mass Properties on Discrete Sublevel Cave Models.....	1997
<i>D. O. Degagné</i>	
1154:Seam-Specific Pillar Strength Formulae for South African Collieries	2005
<i>M. D. G. Salamon</i>	
1157:Modeling Breakout and Near-well Fluid Flow of a Borehole in an Anisotropic Stress Field.....	2018
<i>S. C. Yuan</i>	
1169:A Review of Empirical Methods for Assessing Rock Mass Deformability	2028
<i>L. Richards</i>	

Author Index