

43rd International Conference on Ground Control in Mining (ICGCM 2024)

Held at the 2024 SME Annual Conference & Expo

Canonsburg, Pennsylvania, USA
26 February 2024

Editors:

**Ted Klemetti
Rudrajit Mitra
Michael Murphy**

**Kyle Perry
Ihsan Berk Tulu**

ISBN: 979-8-3313-0048-7

Printed from e-media with permission by:

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

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

Copyright© (2024) by Society for Mining, Metallurgy and Exploration (SME)
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

For permission requests, please contact Society for Mining, Metallurgy and Exploration
at the address below.

Society for Mining, Metallurgy and Exploration Inc.
12999 East Adam Aircraft Circle
Englewood, CO 80112-4167

Phone: (303) 948-4200

Fax: (303) 973-3845

cs@smenet.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

PREFACE	vii
EDITORS AND REVIEWERS	viii
2024 ORGANIZING COMMITTEE	ix
2023 SYD S. PENG GROUND CONTROL IN MINING AWARD	xi
SYD S. AND FELICIA F. PENG GROUND CONTROL IN MINING SCHOLARSHIPS	xii
THE BEST OF GROUND CONTROL IN MINING	xiii

ADVANCES IN GROUND CONTROL

The Influence of Geologic Province on Rock Mass Jointing and Limestone Pillar Stability	1
Phillipson, S.E.	
Standardised Testing and Assessment of Ground Consolidation Products and the Application of the Data	10
Campbell, R., Goonawardene, R., Steed, E., Pirona, C., Giese, S., Saydam, S., Canbulat, I., Kizil, M.	
Ductile Shotcrete Linings for Mining in “Squeezing Ground Conditions”	22
Entfellner, M., Wannemacher, H., Fiest, T., Schubert, W.	
Numerical Study on Mining-Retention Ratio Optimization in Underground Solid Potassium Salt Mine	31
Zhang, J., Zhao, J., Yang, S., Xiaohang Wan, X., Wei, W.	

ADVANCES IN MINE DESIGN ANALYSIS TECHNIQUES

Evaluation of Multiple-Seam Scenarios by Non-Traditional Methods	42
Phillipson, S.E.	
Application of Statistical-Analytical Methods in Ground Control Engineering	55
Maleki, H.	
A Case Study of Path Dependent Calibration and Pillar Stability Analysis Using the LaModel Program	65
Sears, M.M.	
Application of Analysis of Coal Pillar Stability (ACPS) Software for Assessment of Pillar Stability in Underground Lignite Mining—A Case Study	73
Andrews, K., Agioutantis, Z.	

CASE STUDIES

Gob Wells—Is There a Way to Predict Water Makers?	83
Brown, J., Agioutantis, Z., Wedding, Z., Hicks, S.	
Lessons from Recent Pillar “Squeezes” in US Coal Mines	91
Mark, C.	
ICGCM China—History, Networking, and Education	104
Peng, S., Guo, W.B., Du, F., Yang, L., Cheng, J.Yw.	

The Effect of Overburden Depth on Casing Deformations of Shale Gas Wells in Longwall Chain Pillars—Recent Mine-by Experiences	114
Zhang, P., Su, D., Khademian, Z., Tulu, B., Hyun Kim, B.	
Ground Support Optimization Using a Structured Strata Management Process in Wide Set-up Room Roadways at West Elk Mine	129
Stone, R., Munz, B.	

MINE MAPPING TECHNIQUES

Application of Machine Learning and Explainable Artificial Intelligence to Roadway Roof Convergence Data	150
Emery, J., Canbulat, I., Zhang, C., Yao, L.	
Coal-Associated Resources Multi-Layer Development: A Theoretical Framework for Ground Control	159
Li, Y., Wang, N., Wang, J.	
Applications of LiDAR in Underground Mines	167
Muto, E.	
From Points to Lines to Surfaces: A Novel Approach to Reconstructing Field-Scale Three-Dimensional Shale Roof Models Using Image Processing	173
Zhao, G., Tuncay, D., Ruan, M., Berk Tulu, I., Xue, Y., Li, X.	
Best Practice Data Management for Extensometers at Australian Underground Coal Mines	181
Burchmore, S., Melville, M., Emery, J.	

NUMERICAL MODELING APPLICATIONS IN GROUND CONTROL

3DEC Investigation of the Highly Anisotropic Strengths of a Utah Coal Using Discrete Fracture Networks	189
Kim, B.H., Larson, M.K.	
NIOSH Gas Well Stability Research: A Summary of Ground Control Engineering Considerations	198
Su, D., Zhang, P. Tulu, B.	
Underground Coal and Stone Mining near Gas or Oil Wells	206
Rumbaugh, G.M., Mark, C., Santis, L.	
Calibration of LaModel In-Seam Material Properties for Underground Stone Mine Benching Operation by Employing Brittle Failure Criteria in FLAC3D	215
Can Suner, M., Elibol, A., Jimenez, R., Tuncay, D., Agioutantis, Z.	

SEISMICITY

Quantitative Description and Definition of Soft Rock Tunnel	223
Li, Y., Guo, D., Zhao, G., Chen, D., Ma, N.	
Stress Distribution Characteristics and Energy Evolution Law of Drilling Pressure Relief	229
Zhang, K., Li, Y., Chi, X., Yang, K., Zhang, X.	

Seismic Potential Forecasting in a Deep Longwall Mine	237
Khademian, Z., Beale, J., Hicks, S., Fuller, J., Justice, Q., Agioutantis, Z.	
Research on Microseismic Passive Velocity Tomography Based on Template Matching Technology	251
Zhua, Q., Zhaoa, X., Boltz, S., Chambers, D., Westman, E.	

SUBSURFACE GROUND MOVEMENT

Prediction of Ground Movements for Inclined Seams	261
Maldonado, E., Agioutantis, Z., Romero Benitez, J.	
Coal Environmental Protection Mining Technology System and Engineering Practice	271
Li, Q.	
Valley Bottom Upsidence above a Longwall Operation with Strong Overburden Strata	290
Hicks, S., Hasenfus, G., Agioutantis, Z., Wedding, Z.	
A Review of In Situ Horizontal Stress Characteristics in Coal Measures Strata and the Fundamental Role of Poisson's Ratio	298
Frith, R., Reed, G.	

SUPPORT DESIGN

Application and Effectiveness Measurement of Ground Consolidation Products in Longwall Mining	312
Campbell, R., Saydam, S., Canbulat, I., Kizil, M.	
Analysis of Rib Bolt Load and Its Impact on Stabilizing Coal Pillar Ribs Using Numerical Simulations	323
Xue, Y., Mohamed, K.	
Update of the Support Technology Optimization Program: New Features and a New Interface	332
Agioutantis, Z., Barczak, T.M.	
Latest Developments of High Capacity Cable Bolts for Australian Longwall Mines	344
Craig, P., Holden, M., Benjamin, M., Emery, J.	
Investigating the Influence of Lateral Loading on the Vertical Capacity of Coal Mine Standing Supports	352
Mohamed, K., Sears, M., Batchler, T.	
Polyurethane Foam and Alternatives for Void Filling Applications	364
Hamilton, D., Snyder, C.	