Water and the Growth of Global Mining

Mining is growing to meet exploding global demand for metals, industrial minerals, and fuels. Sustainably and responsibly meeting this growth requires reliable mine water technology to allow mines to be permitted, designed, operated, and closed with sustainable and acceptable use and protection of water resources.

IMWA 2013 Mine Water Conference

IMWA 2013 is the International Mine Water Association (IMWA) Annual Conference, held this year at the Colorado School of Mines in the United States from August 5-9, 2013. The theme of the conference is “Reliable Mine Water Technology”, which directly addresses the most serious challenge in mine water today: how to prove that mining can be undertaken while reliably protecting water resources.

To meet this challenge, IMWA 2013 provides the forum where the world’s mine water technologists, practitioners and regulators meet to present and discuss solutions to current and future mine water issues facing the mining, environmental, and regulatory communities. The conference covers the entire state-of-the-art in reliable mine water technology and water management, in the areas of research, science, engineering, services, and operations.

IMWA 2013 is for everybody involved in mine water: mine managers, environmentalists, researchers, regulators, consultants, suppliers, researchers, engineers, geologists, hydrologists, hydrogeologists, geochemists, NGO representatives and other public stakeholders.
Conference Venue: Colorado School of Mines

IMWA 2013 will be held at the Green Conference Center at the Colorado School of Mines, located in the city of Golden, Colorado.

Colorado School of Mines is a public research university devoted to engineering and applied science. Since its founding in 1874, the school's mission and educational programs have been influenced by the needs of society. Those needs are now focused more clearly than ever before. The world faces a crisis in balancing resource availability with environmental protection and Mines and its programs are central to the solution.

Mines has distinguished itself by developing a curriculum and research program geared towards responsible stewardship of the earth and its resources. In addition to strong education and research programs in traditional fields of science and engineering, Mines is one of a very few institutions in the world having broad expertise in resource exploration, extraction, production and utilization, and occupies a unique position among the world's institutions of higher education.

The Green Conference Center

The Cecil H. & Ida Green Graduate and Professional Center (Green Center) was designed for the study of science and technology, and a conference center ideal for meetings, the arts and special occasions.

Located in the heart of CSM, it houses 85,000 square feet of public space including Metals and Petroleum Hall (lecture facilities), Friedhoff Hall (reception area), and Bunker Auditorium (seats 1,100). Each space features full audio-visual and Wi-Fi internet facilities.
Conference Host City: Golden, Colorado

The host city for IMWA 2013 is Golden, Colorado, which nestles at the foot of the Rocky Mountains astride Clear Creek, at an elevation of 5,700 feet. Golden is 15 miles west of Denver and 30 miles from the Denver International Airport. Two mesas - North and South Table Mountains - maintain a charming isolation for the historic Victorian-era city. The city of Boulder is 20 miles to the north, while the historic mining towns of Central City and Blackhawk are 30 miles west.

Golden was founded in 1859 during the Colorado gold rush, and named for Thomas Golden who panned for gold in Clear Creek. The new town grew into a supply center for the gold fields to the west and briefly became capital of the Colorado Territory; today it is the county seat of Jefferson County and its half million people.

The railroad arrived in 1870, and in 1873 Adolph Coors founded a brewery that would become the world's largest. Passenger rail service to Golden ended in 1950 but resumed in 2013 with the opening of the light rail line from Denver's Union Station.

Golden's population of about 19,000 enjoy an average of 270 days of sunshine each year. Daytime temperatures in August will average 80°F with low humidity, and the cool nights will average 55°F.

Golden’s early schools evolved into the Colorado School of Mines with the coming of statehood in 1876. The university swells the population of city by 5,400, and the beautify wooded campus reflects the quiet dynamism of this internationally recognized resource-focused educational institution.

The city has many historic houses, buildings and parklands, and was awarded the 2010 Parks Gold Medal for small US cities. Attractions include Heritage Square Amusement Park, MillerCoors Brewery tours, Buffalo Bill's Museum and Grave, Colorado Railroad Museum, and the nearby Rocky Mountain parks.
### IMWA 2013 Conference Program

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<tr>
<th>Date</th>
<th>Time</th>
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<td><strong>Sunday August 4</strong></td>
<td>08:00-18:00</td>
<td>Workshops and Short Courses (two day)</td>
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<tr>
<td><strong>Monday August</strong></td>
<td>08:00-18:00</td>
<td>Workshops and Short Courses (one and two day)</td>
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<td></td>
<td>18:00-21:00</td>
<td>Registration and Ice-Breaker Reception</td>
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<tr>
<td><strong>Tuesday August 6</strong></td>
<td>08:00-09:30</td>
<td>Registration</td>
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<td>08:30-09:30</td>
<td>Opening Ceremony</td>
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<td>09:30-11:00</td>
<td>Keynote Speeches with Coffee Break</td>
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<td>11:00-12:30</td>
<td>Round Table</td>
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<td>Networking Lunch and Exhibits</td>
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<td>13:30-16:30</td>
<td>Technical Presentations with Coffee Break</td>
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<td>16:30-18:00</td>
<td>Poster Session, Exhibits and Refreshments</td>
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<td></td>
<td>18:00-21:00</td>
<td>Evening social event: Western Style Barbecue - Boettcher Mansion</td>
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<tr>
<td><strong>Wednesday August</strong></td>
<td>08:00-18:00</td>
<td>Mid-Conference Tour - Leadville Mining District</td>
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<td><strong>Thursday August</strong></td>
<td>08:30-12:30</td>
<td>Technical Presentations with Coffee Break</td>
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<td>12:30-13:30</td>
<td>Networking Lunch and Exhibits</td>
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<td>18:00-21:00</td>
<td>Evening social event: Conference Dinner - Brown Palace Hotel Ballroom</td>
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<tr>
<td><strong>Friday August</strong></td>
<td>08:30-12:30</td>
<td>Technical Presentations with Coffee Break</td>
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<td></td>
<td>16:30-18:00</td>
<td>Conference Closure and IMWA 2014 Presentation</td>
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<th><strong>Saturday August 10 - Tuesday August 13</strong></th>
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<td></td>
<td>Post-Conference Tour - Mines, Mountains &amp; Springs</td>
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Workshops and Short Courses
Eight workshops and short courses are offered as part of IMWA 2013. They will take place on the two days prior to the conference, at the Green Conference Center of the Colorado School of Mines. Brief descriptions of the course offerings, and their costs, are presented below. More information: visit [IMWA 2013](#) website.

<table>
<thead>
<tr>
<th>Workshop Title</th>
<th>Instructor(s)</th>
<th>Description</th>
<th>CEUs:</th>
<th>Fee:</th>
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<tr>
<td>Modeling Hydrodynamics and Water Quality of Pit Lakes: A Hands-on Introduction to the Open Source Software PITLAKQ</td>
<td>Dr. Mike Müller, PITLAKQ Creator, Hydrocomputing Inc.</td>
<td>Modelling pit lakes is a complex task. The open source software PITLAKQ allows modeling of hydrodynamic processes in pit lakes including temperature stratification, transport of constituents and a variety of chemical and biological reactions. PITLAKQ combines the abilities of CEQUAL-W2 and PHREEQC. This 2-day workshop (Sunday August 4 and Monday August 5) introduces PITLAKQ with a hands-on tutorial on setting up and running models. Each participant will receive a comprehensive course handout and the PITLAKQ software to use during the course and to keep.</td>
<td>1.3 CEUs will be offered for this course.</td>
<td>$740 per person, $320 for students.</td>
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<td>Application of Microbial Ecology in Mine Waste Management: Tools for Analysis of Microbial Ecology in Mining</td>
<td>Montana State University, Center for Biofilm Engineering: Dr Lisa Kirk, Director; Dr Dana Skorupa, Microbial Research; Dr Chiachi Huang, Biological Ecology; Karen Moll, Student</td>
<td>Growing use of biotechnology in mining remediation, water treatment, hydrometallurgy, and waste facility design requires a knowledge of molecular biology, bioinformatics, and microbial ecology. This one-day hands-on workshop appropriate for mining-industry professionals explores the concepts, methods, and tools needed to manage the microbial ecology of mine environments and will cover microbial ecology and biogeochemical mine waste; sampling requirements; molecular approaches; DNA extraction, amplification and sequencing; and bioinformatics and microscopy.</td>
<td>0.65 CEUs will be offered for this course.</td>
<td>$420 per person, $280 for students.</td>
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<tr>
<td>Mine Water Treatment: Approaches and Applications</td>
<td>Montgomery Watson Harza: Andrew Watson PE, Design/Construction; Karla Kinser PE, Water Treatment Practice Leader; Dan Dupon PE, Advanced Treatment Technologies</td>
<td>Many of the challenges faced by mining companies involve water. This course will focus on managing and treating impacted mine water and will present proven water management approaches and treatment methods for impacted mine water. The workshop will cover mine water management; water balance; mine water pollutants, treatment approaches and treatability testing; advanced and new approaches to mine water treatment; treatment residuals management; and, passive and low-energy applications. The workshop will conclude with evaluation of applications to attendee water treatment problems.</td>
<td>$300 per person, $125 per student.</td>
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<tr>
<td>Introduction to FEFLOW 6.1</td>
<td>DHI-WASY: Julia Mayer, Lead FEFLOW Trainer; Volker Clausnitzer, PhD, Director, DHI-WASI Groundwater Modelling Centre</td>
<td>The FEFLOW finite-element groundwater flow and transport simulation system supports a clear trend towards large and complex groundwater models, requiring sophisticated modeling techniques. This course provides an introduction to FEFLOW modeling of complex subsurface processes: groundwater flow, contaminant transport, density-dependent flow, and unsaturated and variably saturated flow. This workshop offers groundwater modelers expertly guided hands-on practical exercises, providing first-hand experience in model set-up, simulation, and post-processing with FEFLOW 6.1.</td>
<td>A training certificate is offered for this course.</td>
<td>$420 per person, $260 per student.</td>
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## Workshops and Short Courses (continued)

### Geochemistry and Geochemical Modeling of Solution Mining Systems
Dr. Drummond Earley, Geochemist, formerly Research Geochemist, US Bureau of Mines.
Solution mining extraction of copper and other commodities has increased rapidly in recent years, but little emphasis has been placed on reliable prediction and prevention of impacts to water quality from solution mining. This one-day course will cover leaching reactions, rates, and products, and geochemical analysis and modeling to fate and transport of contaminants. The course will focus on acid copper leaching, and is aimed at operational and environmental managers, regulators, hydrometallurgists, geologists, and hydrologists.

*Fee: $200 per person, $150 per student.*

### Passive Treatment of Mine Drainage: Effective Technologies and Design
Dr. Robert Hedin, Hedin Environmental, formerly Research Scientist, US Bureau of Mines
James Gusek PE, Mine Water Treatment Engineer
Passive Treatment is a highly cost-effective remedial option for ARD when properly applied and implemented. Successful implementation requires the collection of useful discharge data, the selection of appropriate treatment technologies, proper design, proper construction, and sustained maintenance. This one-day workshop will provide an understanding of the latest advances in passive treatment, covering treatment chemistry, discharge characterization, tools and technologies, system design, operation and maintenance, and case studies from coal mine and metal mine sites around the world.

*Fee: $250 per person, $175 per student.*

### Advanced Techniques for Removal of Metals and Ammonia from Mine Wastewater
Dan Scroggins P.E. has 35 years’ experience in the waste-water treatment industry and has designed, built, installed, and operated 1,000 plants in 27 countries.
This one-day short course will provide an in-depth review of treatment technologies to remove metals and ammonia from mine wastewater to the part-per-billion range. The course will cover hydroxide precipitation of metals, sulfide precipitation, ion-exchange, iron complexation, clarification, media filtration, membrane filtration, electro-static conditioning, ammonia oxidation, ammonia absorption, ammonia recovery, and residual disposal. The course is aimed at mine, environmental compliance, and health and safety managers.

*Fee: $280 per person, $205 per student.*

### Practices to Ensure Construction of Technically Sound and Economically Justified Dewatering and Production Wells
Dr. Lee Atkinson, Atkinson Mine Water Consultants; Jim Lococo, Mount Sopris International; Kevin McGillicuddy, Roscoe Moss Company; Mark List, Miller Sales and Engineering; Daniel Weber, Montgomery & Associates; Marvin Glotfelty, Clear Creek Associates
Six experts will present well owners, hydrologist, and consultants with an interactive workshop highlighting best practices to ensure construction of technically sound and economically effective dewatering and production wells, under the following topics:
- Build your well around the pump (Atkinson)
- Production logging to find the source of well water (Lococo)
- Selection of water well casing and screen (McGillicuddy)
- Design and analysis of pumping tests (List)
- Pump selection and design of pumping systems (Weber)
- Life-cycle economic analysis of water wells (Glotfelty)

*Fee: $150 per person, $50 per student.*
The theme of IMWA 2013 is “Reliable Mine Water Technology”. The technical program is arranged around seven main topics on this theme, providing for the full range of technical submissions for the conference. This year a new category has been added, covering the water management aspects of coalbed methane, hydrofracking, and produced hydrocarbon waters.

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<td>Flow, transport and quality control at closed mines</td>
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<td>Tight gas extraction water management</td>
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<td>Hydrofracking hydrology and chemistry</td>
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<tr>
<td>Produced water treatment and disposal</td>
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The titles and authors of the 200 papers and posters presented at IMWA 2013 are listed in the following pages, arranged by topic area, and sorted by lead author family name. For more information on these papers, their abstracts can be read through the IMWA 2013 website.
RELIABLE MINE WATER PERMITTING AND REGULATION

Improved Regulation of Water Supply - Olympic Dam Mine, South Australia [Bekesi G, Tyler M, Niejalke D, Waterhouse J]
Groundwater Use and Protection as Part of the Namibian Mining Application [Bittner A, Zingelmann M]
Mining Activity Impact on Water Resources - Western Basin, Witwatersrand Region South Africa [Chetty T, Maswuma Z]
Mine Closure Regulations – Case Scenario in Northern Quebec [Hernandez AM]
Strategic Assessment of Water Resources for the Erongo Uranium Province [Külls C, Bittner A, Marx V]
Managing Water Permits with GIS at Questa Mine [Schoenbacher J]
Mine site water information disclosures in the context of watersheds and reporting frameworks, eastern Australia [Timms W, Leong S, Taplin R, Hazelton J, Laurence D]
Regulating mine water releases into ephemeral streams [Vink S, Robbins S, Roux E]
Development and application of water quality criteria for reliable management of off-site risk [Whittle P, Smith R]
Management of Mine Water Quality Data from Permitting to Compliance to Closure [Wyman S, Harmon M]

RELIABLE MINE WATER HYDROLOGY

Uncertainty as a proxy for reliability using a multiple constraints Model-Data Assimilation approach [Almarza A, Barrett D]
Simulated Mining, Backfilling, and Artificial Recharge of the Corani Open Pit [Bickford FE, Breckenridge JL]
Numeric model calibration using flux & head targets to determine reliable groundwater inflow predictions [Bredenkamp B]
Using Fiber Optics and Vibrating Wire Piezometers to Characterize an Aquifer in Preparation for Ground and Aquifer Freezing [Cottingham CT, Vitale M, Selker J, Lupton S, Selker F]
Designing a Large Scale Pit Slope Depressurization System at Bingham Canyon [Dowling J, Beale G, Bloom J]
An Integrated Model for Mine Dewatering at the Bagdad Mine [Dowling J, Zimmerlund B, Kennealy J, van den Berg E]
Field and laboratory coupled deformation-pore pressure-permeability experiments that provide insight for depressurization of fractured rock slopes [Gale J, Seok E]
Airlift Testing in Exploration Coreholes [Howell RL]
Mine Dewatering in a Compartmentalized Hydrogeologic Setting at Sishen Mine, South Africa [Li H, Nel E, Kotze J, Ding D]
Managing High Altitude Bog Deposits: Hydrogeologic, Geotechnical Challenges of Andean Bofedal Sediments [Luszcz E, Le V]
Quantification of water evaporation by open pit mining lake using lysimeters [Moleiro Cabrera MC, Youlton C, Wendland E]
Combining spinner flow logging & geotechnical information for fractured rock hydraulic properties [Pedder R, El Idrysy H]
Grouting for ensuring coal mining safety above limestone aquifers with high water pressure [Sui W]
Packer Testing Program Design and Management [Swanson EE, Titone BC]
Stream-aquifer interaction in mining conditions using a ground-water flow model [Szczepinski JJ]
Integrating Less-Common Data Sources to Improve Groundwater Model Calibration [Thompson KS, Cadle S]
Water Balances and their Role in Operational Mine Water Management [Wilton MJ, Lupo J]
Methodology of Quantitative Assessment of Mine Water Inflows [Wolkersdorfer C, Rapantova N, Krzeszowski Ś, Gmela A]
Practical Application and Design Considerations for Fully Grouted Vibrating Wire Piezometers in Minewater Investigations [Yungwirth GA, Preene M, Dobr M, Forero Garcia F]
AA leach pad cover design: successful reclamation at a Nevada gold mine [Zhan G, Milczarek M, Keller J, Giraudo J]
RELIABLE MINE WATER GEOCHEMISTRY

Using Humidity Cells Tests to Evaluate an ARD Prevention Approach in Santa Catarina Coal Field, Brazil [Amaral Filho J, Weiler J, Schneider I]

Role of Professional Judgement and Scaling in Interpretation of Water Quality Model Results [Beddoes P, Herrell M, Vandenberg J]

Hydrogeochemistry of the Mine Water from “Bochnia” Salt Mine (Kraków Region, South Poland) [Bezkorowajny A, Czop M, Stochel B, Worsa-Kozak M]

Reliability of an Unlined Tailings Storage Facility for Protecting Water Resources [Breckenridge JL, Bickford FE, Luscz E]

Characterising the Acid Generating Potential of Mine Wastes by means of Laboratory-scale Static and Biokinetic Tests [Broadhurst JL, Bryan C, Becker M, Franzidis J, Harrison S]

Investigating the potential impact of efflorescent mineral crusts on water quality: complementing analytical techniques with geochemical modelling [Camden-Smith BP, Johnson RH, Richardson R, Billing DG, Tutu H]

Characterization and Remediation of Iron(III) Oxide-rich Scale in a Pipeline Carrying Acid Mine Drainage at Iron Mountain Mine, California, USA [Campbell KM, Alpers C, Nordstrom DK, Blum A, Williams A]

MiniSipper: A New, High-capacity, Long-duration, Automated In Situ Water Sampler for Acid Mine Drainage Monitoring [Chapin T, Prosser C, Todd A]

Acid Rock Drainage Challenges and a Path Forward [Chatwin T, Williams D, Creek M]

Interactions between dolomite and acid mine drainage in the Witwatersrand: results of field and laboratory studies and the implications for natural attenuation in the West Rand Goldfield [Coetzee H, Kotoane M, Atanasova M, Roelofse F]

Trace element availability in the abandoned Freixeda gold mine, Portugal [Costa M, Ávila P, Ferreira A, Fereira da Silva E]

Hydrogeochemical Interactions in an Extensively Mined Watershed, Pennsylvania, USA [Cravotta C]

Process sustenance in an organic carbon exhausted chemo-bioreactor by sweetmeat waste dosing [Das BK, Bhattacharya J]

Sulfate Reduction Performance of Sulfate Reducing Bacteria Using Marine Waste Extract as Nitrogen Source [Dev S, Bhattacharya J]

Mine Waste Geochemistry Assessment, Corani Project, Puno, Peru [Dorey R, Larry B]

Use of a Biological Polishing Step to Improve Bioassay Test Results [Fricke J, Dean D]


Control of Tailing Seepage through Reactive Chemical Amendments [Gillow J, Griffin A, Christoffersen L, Divine C, Hay M, DeDycker P]


The adoption of the soil chemical equilibrium approach to solving hydrogeochemical problems [Harley A]

Addition of a Rate Limit to a Shrinking Core Oxidation Model for Predictive Modeling of Mine Water Quality [Helgen SO, Greer B, Nicholson AD]

Reactive transport modeling at uranium in-situ recovery sites: uncertainties in uranium sorption on iron hydroxides [Johnson RH, Tutu H]

Controls on zinc uptake from circum-neutral mine drainage in freshwater biofilms [Jones A, Rogerson M, Greenway G, Mayes WM]

Release of metals from unprocessed and processed black shale due to natural weathering [Karlsson L, Karlsson S, Allard B, Sjöberg V, Bäckström M]

A simple modeling approach for an acid generating, backfilled mine pit [Krusse Daniels NA, Breckenridge JL, Kruse C]

Holistic view of water affaction in the mercury mining district of Asturias (Spain) [Loredo J, Ordoñez A, Alvarez R]

Hydrological Impact Assessment in a Natura 2000 Protection Area in Northern Scandinavia [Lyle S, Barnes A, Stewart M]

Sensitivity of Database Selection in Modeling the Transport of Uranium [Mahoney JJ]

Neutralised Mine Water For Irrigation – Cost And Feasibility Study [Makgae M, Maree J, Annandale J]

Stream sediment geochemistry of the areas impacted by mining around Emalahleni (formerly known as Witbank), South Africa: Fingerprinting AMD potential point sources [Netsitshungulwana R, Yibas B, Novhe ON, Motlakeng T]

Use of an integrated source-to-receptor model to facilitate rapid assessment of water quality impacts during mine planning [Pint T, Hinck P]

Prediction of hydrogeochemical changes due to surface water seepage into 1B Mine Pool, Cape Breton, Canada [Raman C, MacSween J, Shea J, Kaliaperumal R, Oakes K, Mkandawire M]
RELIEABLE MINE WATER GEOCHEMISTRY...

Increasing ARD and rare earth metal concentrations in an alpine watershed [Rue G, Crouch C, McKnight D]
Impact of temperature on weathering rates – a long-term kinetic study on waste rock from Bergslagen, Sweden [Sartz L, Bäckström M]
Modeling Application in Evaluating Environmental Impact due to Phosphate Mining Activities [Song X, Leone G]
Realistic simulation of acid mine drainage generation in the gold mines of the Witwatersrand, South Africa [Tlowana S, Coetzee H, Magkae M]
The role of humic substances in metal attenuation in leachates emanating from abandoned gold tailings footprints [Tutu H, Mavunganidze T]
Selenium in mine waters: a review [Warren BJ]
Application of Column Leaching Tests to Predict Seepage Water Quality from Waste Rock in the Southeast Idaho Phosphate District [Whitmore C, Kaufman M, Effner S]
Natural acid rock drainage in the Judith Mountains, Central Montana, USA [Williams GP, Gammons CH, Parker SR]

RELIEABLE MINE WATER TREATMENT

HybridICE™ filter design in freeze desalinization of mine water [Adeniyi A, Maree J, Mbaya R, Popoola P]
Fly ash injection into weathered mine waste [Bäckström M, Sartz L]
Applications for Hydrous Ferric Oxide mine water treatment sludge [Bailey M, Moorhouse A, Byrom A, Kershaw S]
Treatment Solutions for the Central City/Clear Creek Superfund Site, Colorado [Conroy K, Huff B, Gallagher N]
Water Management and Treatment for the Copperwood Mine Project [Conroy KW, Modeski AM]
Constructed Wetland Treatment Systems for Mine Drainage - Can They Really Provide Green and Sustainable Solutions? [Eger P, Kairies-Beatty C]
Removal of uranium from a neutral mine water using uncoated and iron oxyhydroxide coated iron tailings. [Fahlqvist AL, Bäckström M, Sartz L, Allard B]
Preliminary Results for the Treatment of zinc bearing waters by electrocoagulation [Florence K, Launder M, Sapsford D]
Factors influencing nanofiltration of acid mine drainage [Fornarelli R, Mullett M, Ralph D]
Chromium (VI) removal from effluents using zeolite [Govender-Ragubeer Y, Gericke M]
A Periodic Table of Passive Treatment for Mining Influenced Water - Revisited [Gusek JJ]
infiltration-Diverting Cap and Full-Scale Biochemical Reactor Operation at the Iron King/Copper Chief Mine, Arizona [Gusek JJ, Buchanan RJ, Sorells D]
Research on applicability of anaerobic passive bioreactor to acid mine drainage treatment in Japan [Hamai T]
Strategies for enhancing carbon sequestration in Mg-rich mine tailings [Harrison AL, Power IM, Dipple GM]
Temperature Independent Iron Removal in a Passive Mine Water System [Hedin BC]
Effect of nickel to nutrient removal by selected indigenous protozoan species in wastewater systems [Kamika I, Momba M]
Bioremediation of V5+ and Ni2+ by indigenous Marinobacter Goseongensis isolated from South African Vanadium Mine Waste [Kamika I, Momba M]
Leaching pattern of metals from historic sulphidic mine waste upon addition of bark compost [Karlsson S, Sjöberg V, Grandin A, Allard B]
A Global Perspective on Boron Removal: Treatment Technologies and Practical Applications [Kinser K, Sansom S, Oliver D]
A comparative study of lime doser treatment [Kruse Daniels NA, Bowman JR, Mackey AL, Lopez D]
Habitat and watershed characteristics that limit stream recovery after acid mine drainage treatment [Kruse Daniels NA, Johnson KS, Bowman JR]
RELIABLE MINE WATER TREATMENT...

Optimising mine pit dewatering treatment techniques to meet production deadlines [Lilley T]
Resin Freeze Desalination Process for Acid Recovery [Malisa R, Maree JP, Hardwick E, Oosthuizen F]
Metals Removal from Mine Effluents – Understanding the Chelant is Key [Moore LR, Durand JR, Strickland F]
A high surface area media treatment trial of a circum-neutral, net alkaline coal mine discharge in the South Derbyshire Coal Field (UK) using hydrous ferric oxide. [Moorehouse AML, Wyatt LM, Watson IA, Hall S]
Carbon dioxide impacts both passive treatment system effectiveness and carbon footprint [Nairn RW]
Successful Passive Treatment of Iron-Rich Lead-Zinc Mine Waters and an Effective Method to Address Nuisance Constituents [Nairn RW]
Advances in using sewage sludge to remediate sulfidic mine tailings: An overview from pilot- and field-scale experiments, northern Sweden [Nason PA]
Influence of temperature in sulphate-reducing anaerobic bacteria (SRB) development and metal removal efficiency [Paños NH, Gutierrez LV, Senese AA]
Passive Co-Treatment of Acid Mine Drainage and Municipal Wastewater: Removal of Less Commonly Addressed Metals at Cerro Rico de Potosí, Bolivia [Peer RA, Strosnider WHJ, Winfrey BK, Nairn RW]
Removing barium from saline waters in coal mines of the Upper Silesia (Poland) [Pluta I]
Treatment of high total dissolved solids and acidity in Cerro de Pasco mining wastewater, Peru [Rutkowski T, Rhodes M, Smith J, Conroy K, Bratty M]
Selenium Removal from Effluents in Industrial Mineral Processes [Sanders LA, Moore LR, Durand JR]
Can mining influenced water be an economic resource? [Smith KS, Figueroa LA, Plumlee GS]
Water Filtration Innovation to Optimize Recovery and Lower TCO [Stewart D]
Sulfate Reducing Bioreactor Dependence on Organic Substrates for Long-Term Remediation of Acid Mine Drainage: Field Experiments [Walters ER, Behum PT, Lefticariu L]
Full scale pilot test of a novel technology to remediate alkaline coal mine water using high-surface media at Acomb Mine Water Treatment Scheme, UK [Wyatt LM, Moorhouse AML, Watson IA]

RELIABLE MINE WATER OPERATIONS

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Dugald River Tailings Storage Facility and Process Water Dam – Robust Options Analyses [Clements NM, Noske C]
Water Quality and Compliance Monitoring of Treated Underground and Surface Water at the Grootvlei Proprietary Mines and the Blesbokspruit Wetland, Springs, South Africa [de Wet LD, Sidu S]
Indirect implication of bacterial proteins in the biouptake of metals from aqueous solution [Fosso-Kankeu E, Mulaba-Bafubiandi AF, Barnard T, Campana P]
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Mineral recovery from Lake Katwe brines by isothermal evaporation [Kasedde H, Bäbler M, Kirabira J, Tiliander A, Jonsson]
Glass Bead Filter Packs in Water Wells for Higher Efficiency and Reduced O & M costs [Klaus R]
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Characterization of potential acid leachate from raw coal, discard coal, and slimes from a Colliery in the Witbank Coalfield, Mpumalanga Province, South Africa [Ogola JS, Novhe NO, Maree J]
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RELIABLE MINE WATER CLOSURE


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Rapid field based analytical techniques for the environmental screening of abandoned mine sites [Coetzee H]

Flooding of the underground mine workings of the Witwatersrand Gold Fields [Coetzee H]

Effects of CO2 on pH and Oxidation Rates of Fe(II) in Mining Affected Waters [Cravotta C, Geroni J]

New Insights on Factors Controlling Pit Lake Chemistry [Davis A, Lengke M]


Wetland Photochemistry Control of the Transport of Metals in an AMD-Impacted Watershed [Duren SM, McKnight DM]

Fabricated Soil Using Coal Mine Waste [Firpo Vasquez BA, Homrich Schneider IA, Trein CM]

Arsenic contamination in the Sardinian Baccu Locci mine watershed after remediation [Frau F, Podda F, Da Pelo S, Ardua C]

Monitoring shallow subsurface for gas emission from abandoned underground mines [Frippiat C, Veschkens M, Pacyna D]

Non-conclusive time series analyses – what can we learn on the behavior of the groundwater system? Understanding what caused the collapse of an abandoned drainage tunnel [Frippiat C, Veschkens M, Pacyna D, Funcken L]

Groundwater Stratification and Impact on Coal Mine Closure [Johnstone AC, Dennis J, McGeorge N]


Geochemical Control of Groundwater Quality Changes Resulting from Closure of the Glengarry Adit, New World District, Cooke City MT [Kirk LB, Bozeman LR, Kirk AR, Marks MB]

Passive barriers for long-term containment of Uranium and Vanadium [Külls C, Bittner A]

Substrate and biogeochemical design for sulfate reducing bioreactors [Landkamer L, Lee I, Drennan D, Sharp J, Figueroa L]

Importance of catchment vegetation and design to long-term rehabilitation of acidic pit lakes [Lund MA, Van Etten EJ, McCullough CD]


Aqueous geochemistry of the "other" pit lake in Butte, Montana, USA [McGivern AL, Gammons CH, Duaine TE]

Management of water collection and treatment in the remediation process of an uranium mill tailings site [Metschies T, Laubrich J, Müller J, Paul M, Barnekow U]

Modeling Pit Lake Water Quality – How Do We Solve Multi-Disciplinary Problems? [Müller M]
RELIEABLE MINE WATER CLOSURE...

Performance Boundaries of a Passive Biological Water Treatment System for Arsenic and Radium Immobilisation from Flooded Uranium Mines [Mkandawire M]

Some problems concerning determination of barium in mine waters of the Upper Silesia (Poland) [Musiolik A, Pluta I] Metal pollution sources and transport in mined watershed: an insight from Ermelo Coalfield, South Africa [Novhe N, Netshitungulwana R, Yibas B, Motlakeng T, Sakala]


Ground Water Flow In A Flooded Coal Mine-pool [Perry EF]

Baseline geochemical characterization of trace elements in streambeds in mineralized watersheds of the Duluth Complex, northeastern Minnesota [Piatak NM, Woodruff LG, Seal RR, Jones PM]

Mine Water Quality at Abandoned Uranium Mining Sites in Czech Republic [Rapantova N, Licbinska M, Grmela A, Lusk K]

A Rational Approach to Pit Lake Chemistry Modeling [Richers D, Richardson CD, Hudson A]

Innovative Systems for Mine Closure at the Haile Gold Mine [Rowe J]

Implications of high dissolved organic carbon concentrations on potential copper toxicity in surface waters in the vicinity of Cu-Ni-PGM deposits of the Duluth Complex, northeastern Minnesota [Seal RR, Jones PM, Piatak NM, Woodruff LG]

Vegetation of historical mine waste from the Ljusnarsberg deposit with Agrostis capillaris – Impact on leaching of copper [Sjöberg V, Karlsson S, Grandin A, Allard B]

Enhanced 3-D Visualization as a Powerful Data Analysis and Stakeholder Communication Tool During Mine Closure [Spurlin MS, Rogoff E, Cichy D, Divine C]

Assessment of Legacy Contaminant Remediation at the Phoenix Mine, Nevada [St. Louis RM]

Hydrogeochemistry of Mine Water from “Rudna” mine, South Poland [Stochel B, Czop M, Krzywański Z, Worsa-Kozak M]

Cerro Rico de Potosí, Bolivia: Broader Impacts from Unabated Acid Mine Drainage [Strosnider WHJ, Llanos Lopez FS, LaBar JA, Palmer KJ, Peer RA, Nairn RW]

Radiological effect of mine dumps on surrounding water resources [Tshivhase VM, Mathuthu M]

Development of a 3-D electrical conductivity image for a colliery in South Africa to determine post-closure management options [Vermeulen D, Wessels L, Lukas E]


Hydrodynamics in a flooded underground limestone mine [Wolkersdorfer C, Kahl S, Komischke H, Hasche-Berger A]

Methodology for assessing water pollution and risks associated with abandoned lead-zinc mining at Wanlockhead and Leadhills, southwest Scotland, UK [Wyatt LM, Moorhouse AML, Watson IA, Kershaw S]

A holistic approach towards best management practices of AMD impacts using catchment approach strategy, South Africa [Yibas B, Netshitungulwana R, Novhe O, Mengistu H, Sakala E, Thomas A]

RELIEABLE MINED HYDROCARBON WATER MANAGEMENT


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Suitability of Central Utah’s Navajo Sandstone for Disposal of Mined Hydrocarbon Water [Lachmar T, Randall K]

High Density Polyethylene (HDPE) Lined Produced/Flow-back Water Evaporation Ponds [Nowak N, Briest J]

Addressing Legal, Regulatory, and Risk-Allocation Challenges for Water Reuse in Hydraulic Fracturing [O’Neil DE]

Optimization Factors for Produced Water Management [Stewart D]
Leadville, Colorado

IMWA Mid-Conference Tour: August 7, 2013

All conference attendees are invited to join us to tour the world-famous Leadville mining district, located high in the Colorado Rocky Mountains west of Golden. Buses will depart at 7:30 AM from the Colorado School of Mines and return at approximately 5:30 - 6:00 PM. IMWA 2013 will cover all transportation costs, museum fees, snacks/drinks, and lunch.

Leadville lies at the center of a mining district in the heart of the Rocky Mountains and includes many historic structures and sites from Leadville’s dynamic mining era, with mining and smelting of its world-class silver and lead deposits. Leadville is the highest incorporated “city” in the United States at 10,152 ft (or 3,094 m). Placer gold was discovered here in 1860, but the town’s name comes from the silver-lead deposits that were discovered in 1876. By 1880, Leadville had a population of 40,000 people (at that time, the second largest city in Colorado); now it is around 2,700.

In Leadville, the tour will split up into three groups and rotate between sites, so everyone gets to see it all! In between, we will assemble as one large group for a catered lunch at the ballroom of the National Mining Hall of Fame Convention Center (http://www.mininghalloffame.org/concenter.htm). For stop one, we will see the currently operating Climax Molybdenum Mine (tailings facilities and open cut mine), a subsidiary of Freeport-McMoRan Copper and Gold Inc.

For stop two, we will tour the Leadville National Mining Hall of Fame and Museum (http://www.mininghalloffame.org/) and have a chance to see the historic town of Leadville (http://www.leadville.com/).

For stop three, we will tour some of the legacy mining influences, including one of the major mine drainage tunnels (http://www.usbr.gov/gp/ecaoo/leadville/lmdt_overview.pdf), surface reclamation work, and water treatment facilities (http://www.epa.gov/Region8/superfund/co/calguich/).
Mines, Mountains, and Hot Springs
IMWA Post-Conference Tour: August 10-13, 2013

Come join us for a once in a lifetime tour of colorful Colorado. This tour will have a bit of everything for everyone: geology, mine water, abandoned mines, an operating gold mine, tremendous mountain scenery, historic Colorado mountain towns, wildflowers, and great hot springs to relax in.

Except as noted, all costs are included for the great price of $650 per person and $350 for an accompanying person that shares a hotel room.

Saturday, August 10: From Denver, we will drive through the Rocky Mountains to Glenwood Springs, enjoy the hot springs (www.hotspringspool.com) and lunch in the town. Then on to Silverton, the center of Colorado’s mining boom in the late 1800’s. We will be staying at the Grand Imperial Hotel (www.grandimperialhotel.com), which was built around 1882 and is a true “journey back to the old west”. Cowboy boots and mining picks are optional!

Sunday, August 11: We will spend the day four wheeling! San Juan Backcountry 4x4 tours will do the driving for us in open topped Suburbans (www.sanjuanbackcountry.com) while geologists/hydrologists from the U.S. Geological Survey (www.usgs.gov) explain the geology of the Silverton Caldera, discuss the mining history, and highlight acid rock/mine drainage issues. This will be an unforgettable day of scenery, exploration, and education.

Monday, August 12: We will start the day overlooking the edge of the Silverton Caldera (28 million years old) and then take a tour of the historic Mayflower Mill, which operated from 1930 to 1991, and is now maintained by the San Juan County Historical Society (www.silvertonhistoricalsociety.org). After a catered lunch in the Silverton town park, we will drive through the central Colorado Rockies to the Mt. Princeton Hot Springs Resort (www.mtprinceton.com) with another chance to enjoy some thermal waters out in the fresh Colorado air.

Tuesday, August 13: We will drive to the Cripple Creek Mining District to visit the regional mine drainage system, lunch at a historic hotel in Cripple Creek, and tour Colorado’s largest gold mine operated by the Cripple Creek & Victor Gold Mining Company (www.ccvgoldmining.com). Afterwards we will head back to Denver and Denver International Airport.
### Golden Area Tour (including Buffalo Bill’s Grave) and Denver Museum of Nature and Science

**Day:** Tuesday, August 6, 2013  
**Time:** 10:00 am - 4:00 pm  
**Cost:** $85  
**Includes:** Guided tour of surrounding Golden area, including Buffalo Bill’s Grave and Red Rocks Park, and museum entrance fee  
**Excludes:** Lunch, but available for purchase at T Rex Café in Museum

By his request, Buffalo Bill was buried on Lookout Mountain in 1917, overlooking the Great Plains and the Rockies. Red Rocks Amphitheatre is a rock structure near Morrison, Colorado, where concerts are performed in the open-air amphitheatre. There is a large, tilted, disc-shaped rock behind the stage, a huge vertical rock angled outwards, and several large outcrops angled outwards from stage.

The Denver Museum of Nature & Science inspires curiosity and excites minds of all ages through scientific discovery and the presentation and preservation of the world’s unique treasures. Also in the museum are an IMAX theater and planetarium.

### Georgetown, Georgetown Loop Train Ride, and Argo Mill

**Day:** Wednesday, August 7, 2013  
**Time:** 8:00 am - 5:00 pm  
**Cost:** $115  
**Includes:** Guided walking tour of Georgetown, train ride, mill tour  
**Excludes:** Lunch (purchase in Georgetown)

The Georgetown Loop Railroad® was one of Colorado’s first visitor attractions. Completed in 1884, this spectacular stretch of three-foot narrow gauge railroad was considered an engineering marvel for its time. Today, the loop is again a popular tourist attraction and an exceptional way to see the Clear Creek Valley.

Since its beginning as a mining camp in 1859, Georgetown has attracted those who have sought something very special. First it was the magic of gold and silver ore, now it’s the beauty and ambiance of this picturesque town surrounded by the Rocky Mountains. The Argo Mill was constructed to process the gold bearing ore from these mines. When completed, the Argo would be the largest mill of its type in the world. The mill processed over 100 million dollars of gold ore at the old time prices of $18 to $35 per ounce and stands today as a memorial to the hard rock miners of the day when GOLD WAS KING!

### Rocky Mountain National Park and Estes Park

**Day:** Thursday, August 8, 2013  
**Time:** 8:00 am - 5:00 pm  
**Cost:** $85  
**Includes:** Guided tour and entrance fee to Rocky Mountain National Park  
**Excludes:** Lunch (available for purchase in the town of Estes Park)

THIS IS A "DON'T MISS" TRIP ON YOUR VISIT TO COLORADO. Rocky Mountain National Park’s 415 square miles (1,075 km²) encompass and protect spectacular mountain environments. Enjoy Trail Ridge Road – which crests over 12,000 feet (3,660 m) including many overlooks to experience the sub-alpine and alpine worlds – along with over 300 miles (480 kms) of hiking trails, wildflowers, wildlife, starry nights, and fun times.

### Denver Art Museum and Clyfford Still Gallery

**Day:** Friday, August 9, 2013  
**Time:** 9:00 am - 4:00 pm  
**Cost:** $65  
**Includes:** Transportation and entrance fees  
**Excludes:** Lunch, but will be available for purchase at restaurants around complex

The Denver Art Museum is one of the largest art museums between Chicago and the West Coast, with a collection of more than 70,000 works of art divided between nine permanent collections including African, American Indian, Asian, European and American, modern and contemporary, pre-Colombian, photography, Spanish Colonial, and western American art.

Considered one of the most important painters of the 20th century, Clyfford Still (1904-1980) was among the first generation of Abstract Expressionist artists who developed a new and powerful approach to painting in the years immediately following World War II. This gallery houses all of the art he produced in his lifetime, and is the unique place to see his work.
# IMWA 2013 Registration

## Registration Fees and Options:

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<tr>
<th>Conference</th>
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On the web: [www.IMWA2013.info](http://www.IMWA2013.info)

Questions or Need Assistance?

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