



# MINERALS FOR OUR FUTURE

August 27–30, 2022

Denver, Colorado

[seg2022.org](http://seg2022.org)



[www.segweb.org](http://www.segweb.org)

A woman wearing a blue jacket, a red safety vest with reflective yellow-green stripes, a brown cap, and sunglasses is working on a rocky, uneven terrain. She is using a tool to examine a rock sample. The background shows a steep, rocky hillside under a cloudy sky.

RioTinto

# Discover the job, the challenge.

For 140 years, we've been discovering safer, more effective and more sustainable ways to find mines and process the minerals and metals essential for everyday life.

Exploring eight commodities across 18 countries.

## Conference Hotel

**Sheraton Denver Downtown Hotel**  
1550 Court Place | Denver, Colorado 80202  
Tel. 1 (303) 893-3333



### Wi-Fi Access

Username: MarriottBonvoy\_Conference  
Password: SEG2022

### Speaker Ready Room Client Office 2

Friday: 2:00pm-6:00pm  
Saturday-Monday: 7:00am-5:00pm  
Tuesday: 7:00am-12:00pm

### Registration

Friday: 3:00pm-6:00pm  
Saturday-Monday: 7:00am-6:00pm  
Tuesday: 7:00am-12:00pm

## Exhibits and Posters

**Friday:** 2:00pm-6:00pm Exhibitors/Poster set-up  
**Saturday:** 8:00am-2:00pm Exhibitors/Poster set-up  
4:30pm-6:00pm Welcome Reception  
**Sunday:** 10:00am-6:00pm Exhibits/Posters open  
**Monday:** 10:00am-6:00pm Exhibits/Posters open  
5:00pm-6:00pm Exhibits/Poster Reception  
**Tuesday:** 9:00am-12:00pm Exhibits/Posters open  
12:00pm-2:00pm Exhibits/Posters takedown

Sunday, 6:00pm-8:00pm

### Awards Ceremony and Reception

Monday, 6:00pm-8:00pm

### Industry Outlook Dinner

Speaker: Jeff Pontius, Corvus Gold Founder

For additional information, including Pre- and Post-conference, Social, Early Career and Student Events, please visit the conference website at [www.seg2022.org](http://www.seg2022.org)

All Technical Sessions, listed below, are available on-line and hosted at the conference hotel. Times are MDT, Denver.

## SUNDAY

8:00am-8:15am

### Welcome Remarks

Moira Smith, Conference Chair, Brian Hoal, SEG Executive Director

8:15am-8:45am

### Keynote Session 1

Supply and Demand in a Green Economy

8:45am-10:15am

### Plenary Session 1

Social and Environmental Impacts of Resource Development

10:45am-12:15pm

SESSION 01

### Social and Environmental 1: Responsible and Sustainable Practices

SESSION 02

### Special Session on Innovation

1:30pm-3:00pm

SESSION 03

### New Frontiers 1: Magmatic Models

SESSION 04

### Critical Minerals 1: Sustainably Powering the Future

3:30pm-5:00pm

SESSION 05

### New Frontiers 2: Geochemical and Mineral Vectoring

SESSION 06

### Critical Minerals 2: Special Session on Lithium

## MONDAY

8:00am-8:30 a.m.

### Keynote Session 2

- Vital Metals and Critical Minerals
- Uranium Supply and Demand

8:30am-10:30am

### Plenary Session 2

Vital Metals: Supply and Demand-Age-Old Questions Revisited

11:00am-12:30pm

SESSION 07

### Vital Metals 1: Geological Models

SESSION 08

### Critical Minerals 3: Case Studies

1:30pm-3:00pm

SESSION 09

### Vital Metals 2: Deposit Models 1

SESSION 10

### Recent Innovations 3: Hyperspectral Imaging

3:30pm-4:20pm

### In-Person Speed Talks 1:

Critical/Vital Minerals

### In-Person Speed Talks 2: New Frontiers/Recent Innovations

## TUESDAY

8:00am-8:30am

### Keynote Session 3

Full Value Chain

8:30am-10:30am

### Plenary Session 3

Future Outlook-Minerals and Careers

11:00am-12:30pm

SESSION 11

### Vital Metals 3: Deposit Models 2

SESSION 12

### Recent Innovations 2: Hyperspectral and XRF Data Techniques

**Tuesday afternoon sessions may change. See conference website.**

1:30pm-3:00pm

SESSION 13

### Vital Metals 4: Mineral Exploration

SESSION 14

### Recent Innovations 3: Exploration Applications

3:30pm-5:00pm

SESSION 15

### Value Chain 1: Sources of Supply

3:36pm-4:31 pm

### In-Person Speed Talks 3

### SEG 2023 Introduction *Bob Foster*

## ***A Warm Welcome to the SEG 2022 Conference!***



**Thank you for joining us as we explore this year's conference theme, *Minerals For Our Future*.**

As SEG begins its second century, the world is experiencing, or is forecast to experience, an unprecedented acceleration in demand for a large number of metals and minerals to keep up with technological advances and changes in how we power the world. At this meeting, SEG will focus on how we can help meet these needs, from uses of and markets for these vital and critical minerals and metals, through discovery, exploration, mining, and marketing them. Whether your attendance is virtual or in person, we hope you'll take advantage of the full slate of activities and technical sessions.

Virtual events allow attendees to connect with peers around the world through workshops, social events, and a mentor/mentee program. Field trips provide the vital, boots-on-the-ground component that has been missed by SEG conference attendees during the past two years. Social activities allow participants to reunite with or make new friends, honor our SEG award winners, listen to a dinner talk by one of our successful explorers, and interview the poster presenters. Finally, an exceptional emphasis is placed on providing opportunities for students and early career professionals to discuss ideas and connect with peers on a global basis. Thank you for joining us—in person or online at the Sheraton Denver Downtown Hotel—to begin our journey into the future!



**Moira Smith**  
*Conference Chair*



**Brian Hoal**  
*SEG Executive Director*



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## Conference Information

### Conference Organizing Committee

- **Conference Chair:** Moira Smith
- **SEG Executive Director:** Brian Hoal
- **Technical Program:** Borden Putnam and Edith Newton Wilson
- **Speed Talks and Posters:** Keiko Hattori and Rowena Duckworth
- **Workshops:** Alan Wilson and Kathryn MacWilliam
- **Exhibits:** Paola Chadwick and Mike Tucker
- **Early Career Professionals and Students:** Halley Keevil and Isaac Simon
- **Specialty Metals Session:** Simon Jowitt and Stephanie Mills
- **Panel Discussion:** Simon Jowitt and Peter Megaw
- **Community Relations:** Deanne Rider
- **Social Events:** Mary Little and Jill Nelson

### SEG Contact Information

7811 Shaffer Parkway  
Littleton, CO 80127-3732  
Tel. 1.720.981.7882  
E-mail: [seg@segweb.org](mailto:seg@segweb.org)

### Conference Organizer

Meeting Expectations  
[organizer@seg2022.org](mailto:organizer@seg2022.org)

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For registration and exhibit hours and an overview of schedules, please refer to the inside front cover. A conference area floor plan is on the inside back cover.

**For updates and latest information,  
visit [www.seg2022.org](http://www.seg2022.org).**



## SEG Awardees for 2022

Please join us at 6:00 pm, Sunday, August 28, for the SEG Award presentations in the Plaza Ballroom A/B at the Sheraton Downtown Denver Hotel. The event begins with a cash bar and hors d'oeuvres prior to the ceremony.

R.A.F. Penrose Gold Medal

**ROSS R. LARGE**

Emeritus-CODES, University of Tasmania

SEG Silver Medal

**JENS GUTZMER**

Helmholtz Institute Freiberg for Resource Technology,  
Germany

SEG Waldemar Lindgren Award

**MICHAEL ANENBURG**

Australian National University

SEG Ralph W. Marsden Award

**ANNE J.B. THOMPSON**

PetraScience Consultants, Canada

Brian J. Skinner Award

**NICOLE C. HURTIG**

New Mexico Tech, United States

SEG Distinguished Lecturer

**ELIZABETH A. HOLLEY**

Colorado School of Mines, United States

International Exchange Lecturer

**KEIKO HATTORI**

University of Ottawa, Canada

SEG Thayer Lindsley Visiting Lecturer

**HARTWIG E. FRIMMEL**

University of Würzburg, Germany

Regional Vice President Lecturer

**CAROLINE S. PERRING**

BHP, Australia

SEG Honorary Fellow

**PETER LAZNICKA**

Metallogenica Consulting Adelaide, Australia



# Technical Program

Sessions will be available both to those attending in person and to those viewing online.

## Day 1 – Sunday, August 28, 2022

### Opening and Welcoming Remarks

8:00 am – 8:15 am **Opening and Welcoming Remarks**  
*Brian Hoal, Moira Smith*

### Keynote Session 1 – Supply and Demand in the Green Economy

*Co-Chairs: Moira Smith, Edith Wilson*

8:15 am – 8:45 am *Doug Silver (Keynote Speaker)*

### Plenary Session 1 – Social and Environmental Impacts of Resource Development

*Co-Chairs: Moira Smith, Edith Wilson*

8:45 am – 9:15 am **Communicating the Importance of Minerals Critical for Sustainable Development to Diverse Audiences**  
*Murray Hitzman (Invited Speaker)*

9:15 am – 9:45 am **Imbalance of the Geologic Endowment of Mineral Resources and their Global Demand – Who Benefits? Reflections from Experiences in the Democratic Republic of the Congo**  
*Robert North (Invited Speaker)*

9:45 am – 10:15 am **Copper Supply and Demand**  
*John Tumazos*

10:15 am - 10:45 am Break

**Oral Session 01**  
**Social and Environmental 1: Responsible and Sustainable Practices**  
*Chair: Borden Putnam*

- 10:45 am – 11:00 am **Leaving a Positive Legacy, Making a Difference in Africa**  
*Robert Kaemba (Invited Speaker)*
- 
- 11:00 am – 11:15 am **Leaving a Positive Legacy, Making a Difference in Africa, Cont'd**
- 
- 11:15 am – 11:30 am **Metal Sourcing for a Sustainable Future**  
*Richard Gloaguen*
- 
- 11:30 am – 11:45 am **A New Paradigm for Responsible Exploration and Sustainable Mining**  
*Gregory Wessel*
- 
- 11:45 am – 12:00 pm **Predicting the Impact of Mining on Watersheds: a Case Study from the Ocoña Watershed in Arequipa, Peru**  
*Isaac Simon (Student)*

**Oral Session 02**  
**Special Session on Innovations**  
*Co-Chairs: Rebecca Sproule, Edith Wilson*

- Satellite Communications and Space Exploration: Connecting Remote Industry at the Speed of Light**  
*Matthew Pearson (Invited Speaker)*
- 
- Bayesian Exploration: How Statistics Went Wrong, and How We Can Do Them Better in Mineral Exploration**  
*Kurt House (Invited Speaker)*
- 
- Generating Ore Body Knowledge from Core Photography Using Computer Vision: a Case Study from Agnico Eagle's Fosterville Mine**  
*Brenton Crawford*
- 
- Low Level Gold by pXRF is Now a Reality; Exploration Examples Following Extensive Global Tests**  
*Simon Bolster*
- 
- Innovation Reality Check: We Haven't Reinvented the Wheel**  
*Shawn Hood (Invited Speaker)*

**Day 1 – Sunday, August 28, 2022 (Continued)****Oral Session 01 (Cont.) – Social and Environmental 1: Responsible and Sustainable Practices**

12:00 pm – 12:15 pm **Coexistence Between Large-scale Mining (LSM) and Artisanal and Small-scale Mining (ASM) in Peru and Colombia**  
*Oscar Rodriguez (Student)*

12:15 pm – 1:30 pm Lunch

**Oral Session 03  
New Frontiers 1: Magmatic Models**  
*Chair: Ross Large*

1:30 pm – 1:45 pm **Evolution of Magmatic-Hydrothermal Systems Forming Porphyry Copper Deposits: Results of Quartz Solubility Modeling**  
*Thomas Monecke*

**Oral Session 04  
Critical Minerals 1: Sustainably Powering the Future**  
*Chair: Edith Wilson*

**Resources for Carbon Neutrality: What Are They, Are They Available, and Where Will They Come From?**  
*Adam Simon*

1:45 pm – 2:00 pm **Field Observations of Magmatic Silica Caps in Over-Pressured Felsic Cupolas: Evidence for the Magmatic to Hydrothermal Transition**  
*Douglas Kirwin*

**An Integrated Perspective on Lithium Mineral Systems**  
*Edward Bunker*

2:00 pm – 2:15 pm	<b>Assessing the Role of Tectono-magmatic Setting in the Precious Metal (Au, Ag, PGE) and Critical Metal (Te, Se, Bi) Endowment of Porphyry Cu Deposits</b> <i>Katie McFall</i>	<b>A New Century for Nickel; Assessing Global Reserves, Resources, and Sustainability of the Devil's Metal</b> <i>Simon Jowitt</i>
2:15 pm – 2:30 pm	<b>Constraints of Magma, Metal and Sulfur Sources Provide Insight into the Formation of the Taca Taca Bajo Cu-Mo-Au Porphyry Deposit (NW Argentina)</b> <i>Madeleine Ince</i>	<b>Exploration 2.0: Systems to Discovery</b> <i>Nicole Januszczak</i>
2:30 pm – 2:45 pm	<b>Zircon Oxybarometry and Hygrometry Discriminate Porphyry-Copper Ore-Forming Magmas from Ordinary, Infertile Arc Magmas: Guides to Exploration Targets</b> <i>Robert Loucks</i>	<b>Critical Minerals in Porphyry Cu-Mo and other Intrusion-related Deposits of the Western United States</b> <i>Peter Vikre</i>
2:45 pm – 3:00 pm	<b>Sulfur Isotope Systematics of Granitoids from the Yilgarn Craton Shed New Light on the Fluid Reservoirs of Neoproterozoic Orogenic Gold Deposits</b> <i>Stefano Caruso</i>	<b>Quantitative Assessment of Future Lithium Supply: Which Mining Projects and When?</b> <i>Laura Andrade (Student)</i>
3:00 pm – 3:30 pm	Break	

## Day 1 – Sunday, August 28, 2022 (Continued)

	<b>Oral Session 05</b> <b>New Frontiers 2: Geochemical and Mineral Vectoring</b> <i>Chair: Scott Briscoe</i>	<b>Oral Session 06</b> <b>Critical Minerals 2: Special Session on Lithium</b> <i>Chair: Halley Keevil</i>
3:30 pm – 3:45 pm	<b>Geology from Geochemistry, an Emerging Opportunity</b> <i>Ross Large</i>	<b>Potential Domestic Sources of Critical Minerals for Our Energy Future</b> <i>Jane Hammarstrom</i>
3:45 pm – 4:00 pm	<b>Vectors to Porphyry Copper Deposits Hosted in Carbonate Rocks: an Update on the Bingham to Stockton Carbonate Transect Geochemistry</b> <i>Michael Kirschbaum (Student)</i>	<b>Cornish Lithium: Unlocking Unconventional Lithium Deposits to Accelerate the Energy Transition in the UK</b> <i>Rebecca Paisley</i>
4:00 pm – 4:15 pm	<b>Mineralogical and Geochemical Vectoring Techniques in Advanced Argillic-Altered Rocks of British Columbia</b> <i>Farhad Bouzari</i>	<b>Trace Element Signatures of Quartz from Li-Cs-Ta Pegmatites as Exploration Vectors for Li-mineralization: Examples from Austria and Ireland</b> <i>William Keyser</i>
4:15 pm – 4:30 pm	<b>Assessment of Tourmaline Composition as a Vectoring Tool for Sn-W Deposits – the Góis-Panasqueira-Segura Belt (Central Portugal)</b> <i>Miguel Gaspar</i>	<b>Low-density Mapping of Lithium Concentration in Stream Sediments and Definition of Geochemical Background in Minas Gerais State, Brazil</b> <i>Luísa Guerra (Student)</i>

4:30 pm – 4:45 pm **Pyrite Geochemistry as a Vector Toward Mineralization in Irish-type Zn-Pb Deposits**  
*Claire Geel*

**U-Pb Geochronology of LCT and NYF Pegmatite Occurrences of the Northern Appalachians**  
*Christopher Holm-Denoma*

4:45 pm – 5:00 pm **Assessment of Wolframite-Scheelite Replacement as a Vectoring Tool In Sn-W Lode Deposits – a Case Study of the Argozelo Mine (NE Portugal)**  
*Pedro Francisco (Student)*

**Discussion with presenters about meeting the growing lithium demand**

## Day 2 – Monday, August 29, 2022

### Keynote Session 2 – Vital Metals and Critical Minerals

*Co-Chairs: Borden Putnam, Edith Wilson*

8:00 am – 8:30 am **Uranium Supply and Demand**  
*Rick Rule (Keynote Speaker)*

### Plenary Session 2 – Vital Metals: Supply and Demand – Age Old Questions Revisited

*Co-Chairs: Edith Wilson, Borden Putnam*

8:30 am – 9:00 am **Copper Supply and Demand**  
*John Tumazos*

9:00 am – 9:30 am **Critical Minerals for Our Energy Future: Geology and Ore Deposit Models**  
*Frances Wall*

**Day 2 – Monday, August 29, 2022 (Continued)**9:30 am – 10:00 am **Vital Metals for Our Future: a European Perspective***Edine Bakker*10:00 am – 10:30 am **Ideas that Must Live and Die in Exploration***Ahmad Saleem/Steve Beresford*

10:30 am – 11:00 am Break

**Oral Session 07****Vital Metals 1: Geological Models***Co-Chairs: Stephanie Mills, Meghan Chesal***Oral Session 08****Critical Minerals 3: Case Studies***Chair: Simon Jowitt*

11:00 am – 11:15 am

**Cobalt and Copper Mineralisation in the Fungurume 88 Deposit***Bjorn von der Heyden***A Devonian Re-Os Age for the Bou Azzer Co-Ni-As Deposit, Morocco***Holly Stein*

11:15 am – 11:30 am

**Are Mafic Rocks a Source of Cu, Co, Ni and V in the Central African Copperbelt?***Zoe Phelps-Barber (Student)***The Fishtie Cu-Co Deposit, NE Zambia: Stratigraphy, Structural Architecture, Hydrothermal Alteration, and Mineralization***Subaru Tsuruoka*

11:30 am – 11:45 am

**Exploration for Sediment-Hosted Copper in Europe Using Mineral-system Analysis with Hydrocarbon Data***Howard Golden***Isotopic and Trace Element Signatures of Calcite, Apatite and Zircon from Carbonatite Liquid Associated with Cu-Ni-PGE Mineralization***Maria Cherdantseva (Student)*

11:45 am – 12:00 pm	<b>The Shale-hosted Las Cruces VMS, Iberian Pyrite Belt, Spain: Not a Brine Pool Deposit</b> <i>Simon Jones</i>	<b>Graphite Re-Os Dating</b> <i>Jonathan Toma</i>
12:00 pm – 12:15 pm	<b>An Experimentalist View into Natural Carbonatite Complexes</b> <i>Michael Anenburg</i>	<b>Integrating Mineralogical and Geochemical Data Across Scales for Improved Geophysical Data Interpretation: A Case Study from the Idaho Cobalt Belt, USA</b> <i>Daniel Schmidt (Student)</i>
12:15 pm – 12:30 pm	<b>Long-term Relief Evolution of the Andean Chain in the Bongará Region (Northern Peru): Implications for the Genesis of Supergene Ore Deposits</b> <i>Anna Sorrentino</i>	<b>Want to Make an Impact? Become a Production Geologist</b> <i>Peter Taylor</i>
12:30 pm - 1:30 pm	Lunch	
	<b>Oral Session 09</b> <b>Vital Metals 2: Deposit Models 1</b> <i>Co-Chairs: Doug Kirwin, Stephanie Mills</i>	<b>Oral Session 10</b> <b>Recent Innovations 3: Hyperspectral Imaging</b> <i>Chair: Wilson Bonner</i>
1:30 pm – 1:45 pm	<b>Hydrothermal Mineral Systems Related to the Breakup of the Supercontinent Pangea</b> <i>Mathias Burisch</i>	<b>Hyperspectral Mineral Mapping with UAVs: Challenges and Opportunities for Minerals Exploration</b> <i>Sam Thiele (Invited Speaker)</i>



**Day 2 – Monday, August 29, 2022 (Continued)**

1:45 pm – 2:00 pm	<b>Multiple Metal and Fluid Sources Inferred for the Ernest Henry Iron Oxide Copper Gold (IOCG) Deposit, Queensland, Australia: Insights from Magnetite O, Fe, and Ti Isotopes</b> <i>Christopher Emproto (Student)</i>	<b>Hyperspectral Imaging for Lithium Exploration and Mining</b> <i>Laura Tusa</i>
2:00 pm – 2:15 pm	<b>Exploration Search Space Constraints for Copper-Gold Host Rocks in the Timok Magmatic Complex</b> <i>Alan Wainwright</i>	<b>Hyperspectral Core Imaging: Advanced Modern Exploration Techniques at the Toiyabe Exploration Project</b> <i>David Browning</i>
2:15 pm – 2:30 pm	<b>Magnetite Chemistry as Exploration Tool to Constrain Fertility and Hydrothermal Evolution in IOCG and Porphyry Environments. San Matías District, Northern Colombia</b> <i>Julian Manco (Student)</i>	<b>The Use of Hyperspectral Remote Sensing for Mineral Exploration in Italy: the Punta Corna Co-Ni Vein System (Piedmont, Italy)</b> <i>Rita Chirico (Student)</i>
2:30 pm – 2:45 pm	<b>Assessing Proximity to Iron Oxide-Copper-Gold (IOCG) Mineralization Using Monazite Chemistry</b> <i>Caroline Tiddy</i>	<b>Multi-source Hyperspectral Imaging of Drill-cores for the Exploration of Sedimentary Base-metal Deposits</b> <i>Moritz Kirsch</i>
2:45 pm – 3:00 pm	<b>High-REE Mafic Magmatism in the Mojave: The Shonkinite Connection Between Mountain Pass and Bobcat Hills, California</b> <i>Kathryn Watts</i>	<b>Hyperspectral Imaging for Mapping Outcropping Li-bearing Pegmatites</b> <i>René Booyesen</i>

3:00 pm – 3:30 pm Break

**In-Person Speed Talks Session 1, Critical/  
Vital Minerals**

*Chair: Zhaoshan Chang*

**In-Person Speed Talks Session 2, New Frontiers/  
Recent Innovations**

*Chair: Simon Jowitt*

3:30 pm – 3:35 pm

**Geology and Mineral Resources of the Hicks Dome Fluorite - Barite - Rare Earth Elements Deposit, Hardin County, Illinois**  
*Laurence Nuelle*

**Machine Learning – the Magic Wand for the Mining Industry?**  
*Annelie Lundström*

3:35 pm – 3:40 pm

**Structural Controls and Paragenesis of Mineralization at the Juomasuo Gold-Cobalt deposit, Kuusamo Schist Belt, northeastern Finland**  
*Aaron Davies*

**Automated Drillhole Target Generation for In-mine Grade Control and Out-of-Sample Resource Definition Using Site Models and Economic Constraints**  
*Farzi Yusufali*

3:40 pm – 3:45 pm

**Foliation Boudinage Structures at the Mount Isa Cu-Pb-Zn System, Australia**  
*Benjamin Williams (Student)*

**Sequential Planning of Downhole Geophysical Surveys in Mineral Explorations by Optimizing Efficacy of Information**  
*David Zhen Yin*

3:45 pm – 3:50 pm

**The Santo Tomás Deposit, Sinaloa, México: A Particularly Structurally Controlled Porphyry Cu-Mo System and Its Metallogical Implications**  
*Jocelyn Pelletier*

**Optimization of Mineral Exploration Borehole Planning Using Partially Observable Markov Decision Processes with Belief-based Rewards**  
*Tyler Hall (Student)*

**Day 3 – Monday, August 29, 2022 (Continued)**

3:50 pm – 3:55 pm	<b>Critical Mineral Potential of Jurassic Magmatic Systems in the Eastern Basin and Range</b> <i>Stephanie Mills</i>	<b>Roadmap to Multi-scale 3D Geological Modelling from Drill-core Hyperspectral Data</b> <i>Roberto De La Rosa (Student)</i>
3:55 pm – 4:00 pm	<b>Metallogeny and Exploration Strategy for Alkaline Volcanic Rocks Hosting World Class Be-U-F Mineralization at Spor Mountain, Utah, U.S.A.</b> <i>Nora Foley</i>	
4:00 pm – 4:05 pm	<b>Manganese Deposits within the Cape Supergroup and their Relation to Thermal Springs</b> <i>Rutger La Cock (Student)</i>	<b>Predictive Mineralogy in Mineral Exploration and Waste Rock Management</b> <i>Katharina Pfaff</i>
4:05 pm – 4:10 pm	<b>Sulfur Isotope and PGE Decoupling During Silicate Melt-Sulfide Liquid Equilibration</b> <i>Anne Virnes (Student)</i>	<b>Prospective Mapping of Carbonatite-associated Iron Oxide Mineralization in the Western Oulad Dlim Massif: Remote Sensing, Field, and Geochemical Investigations</b> <i>Cheikh Elwali Malainine (Student)</i>
4:10 pm – 4:15 pm	<b>Magmatic and Hydrothermal Controls on the Evolution of Ni-Co Mineralization in the Late Jurassic Alaskan-type Mafic-Ultramafic Turnagain Complex</b> <i>Kiera Broda (Student)</i>	<b>Using AI to Extract Information from Legacy Documents</b> <i>Amit Juneja</i>

4:15 pm – 4:20 pm **The Thermodynamic Properties of Carrollite (CuCo<sub>2</sub>S<sub>4</sub>) and Their Application in Modeling Hydrothermal Co(-Cu) Ore-formation**  
*Robert Collar (Student)*

**Day 3 – Tuesday, August 30, 2022**

**Keynote Session 3 – Full Value Chain**

*Co-Chairs: Francisco de Azevedo, Moira Smith*

8:00 am – 8:30 am **Responsible Critical Minerals: a Comparative Assessment of Production Scenarios**  
*Elizabeth Holley (Keynote Speaker)*

**Plenary Session 3 – Future Outlook – Minerals and Careers**

*Co-Chairs: Francisco de Azevedo, Moira Smith*

8:30 am – 9:00 am **Minerals for a Changing World**  
*Nedal T. Nassar (Invited Speaker)*

9:00 am – 9:30 am **Supply Chains for Advanced Technologies and the Green Transition**  
*Anders Sand (Invited Speaker)*

9:30 am – 10:00 am **What the Future Holds: a Personal View of Geologists' Challenges and Opportunities in a Changing World**  
*Sally Goodman (Invited Speaker)*

10:00 am – 10:30 am **Propagation of Bias: the Data Behind the Damage of “Do Your Time”**  
*Stephanie Mills (Invited Speaker)*

10:30 am – 11:00 am Break

## Day 3 – Tuesday, August 30, 2022 (Continued)

	<b>Oral Session 11</b> <b>Vital Metals 3: Deposit Models 2</b> <i>Co-Chairs: Meghan Chesal, Stephanie Mills</i>	<b>Oral Session 12</b> <b>Recent Innovations 2: Hyperspectral and XRF Data Techniques</b> <i>Chair: Rebecca Sproule</i>
11:00 am – 11:15 am	<b>Sulfide-Silicate Garnetiferous Selvages and Host Rock Perspectives in the Nova-Bollinger Ni-Cu Deposit, Fraser Zone, Western Australia</b> <i>Joshua Chong (Student)</i>	<b>Alteration Zonation Patterns Characterized by Hyperspectral Data within Orogenic Gold Deposits of the Ahafo South Camp, Sefwi Granite-Greenstone Belt, Ghana</b> <i>Adu Agyapong</i>
11:15 am – 11:30 am	<b>Rare Earth Elements in Coal Combustion By-products of Saskatchewan: a Geochemical, X-ray Adsorption Spectroscopy, and Machine Learning Investigation</b> <i>Brendan Bishop (Student)</i>	<b>Transferring Knowledge from Exploration to Minerals Processing: Innovative Use of Hyperspectral Imaging and Litho-geochemistry for Predictive Geometallurgy</b> <i>Rocio Vargas Soto (Student)</i>
11:30 am – 11:45 am	<b>An Abrupt Switch in Magmatic Plumbing Taps Porphyry Copper Deposit-forming Magmas</b> <i>Lawrence Carter (Student)</i>	<b>Machine Learning to Boost Hyperspectral Imaging</b> <i>Richard Gloaguen</i>
11:45 am – 12:00 pm	<b>Twin Canyon, Gold Mineralization in a Hydrocarbon Reservoir</b> <i>Jon Thorson</i>	<b>Collection of X-Ray Fluorescence Analyses of Reverse Circulation Drill Chips as a Tool in Geological and Alteration Modeling at the Castle Mountain Gold Deposit, California</b> <i>Erik Tharalson</i>

12:00 pm – 12:15 pm **Fluid Evolution and Ore Genesis of the Permian Hongshanliang Manto-type Copper Deposit in the Eastern Tianshan**  
*Liandang Zhao*

**Getting the Most from Lab and pXRF Multi-element Geochemistry with Examples from the Red Lake Gold Complex, Ontario, Canada**  
*Ned Howard*

12:15 pm – 12:30 pm **FAMOS Insights into the Magmatic Plumbing Systems that Control the Genesis of Porphyry Copper Deposits**  
*Jamie Wilkinson*

**Application of High Resolution XRF Core Scanning in Early-Stage Mineral Exploration to Characterize the Distribution of Critical Metals**  
*Hugh de Souza*

**Lunch and afternoon schedules may be shortened by 30 minutes. Please consult the conference Technical Session schedule for latest updates.**

12:30 pm – 1:30 pm Lunch

**Oral Session 13**  
**Vital Metals 4: Mineral Exploration**  
*Co-Chairs: Mary Little, Stephanie Mills*

1:30 pm – 1:45 pm **The Importance of Coherent Geologic Maps in Mineral Exploration**  
*Dean Peterson*

**Oral Session 14**  
**Recent Innovations 3: Exploration Applications**  
*Chair: Joel Hrominchuk*

**Evaluation of the Tungsten Potential in the Eastern Alps – New Insights from Geological, Mineralogical and Chemical Data on Scheelite**  
*Florian Altenberger (Student)*

1:45 pm – 2:00 pm **Newmont Geochemistry, the Untold Story**  
*Simon Marshall*

**Tracking Sediment Provenance in a River Basin for Mineral Exploration: the Sediment Fingerprinting Technique**  
*Jorge Crespo*

**Day 3 – Tuesday, August 30, 2022 (Continued)**

2:00 pm – 2:15 pm	<b>Exploring New Business Models for Mineral Exploration</b> <i>Martha Henderson (Student)</i>	<b>Mineral Zoning in Greisen Systems: Temporal and Spatial Evolution of the Sadisdorf Greisen and Vein-style Sn-W-Li-Cu Prospect, Germany</b> <i>Dino Leopardi (Student)</i>
2:15 pm – 2:30 pm	<b>Decision Theoretic Methods for Mineral Exploration</b> <i>John Mern</i>	<b>3D Locally Varying Anisotropy Fields Produced Automatically From Sparse, Continuous Numeric Point Data</b> <i>Samuel Cantor</i>
2:30 pm – 2:45 pm	<b>Are Non Invasive Methods of Exploration Efficient?</b> <i>Richard Gloaguen</i>	<b>Machine Learning for Lithologic and Ground Type Modeling at the Stillwater Mine</b> <i>Gretchen Moore</i>
2:45 pm – 3:00 pm	<b>Modelling Carbon Sequestration Capacity of Ultramafic Rocks for Use as a Criteria for Critical Metal Exploration in British Columbia, Canada</b> <i>Dianne Mitchinson</i>	<b>Whole Rock Analysis with LIBS – Paving the Way to Downhole Chemical Investigations</b> <i>Fernando Fagundes Fontana (Student)</i>
3:00 pm – 3:30 pm	Break	

**Oral Session 15**  
**Value Chain 1: Sources of Supply**  
*Chair: Edith Wilson*

- 3:30 pm – 3:45 pm **The Russia-Ukraine Conflict; Understanding Short- and Long-term Impacts on Metal and Mineral Supply Chains and Prices**  
*Simon Jowitt*
- 
- 3:45 pm – 4:00 pm **Global Potash Supply Chain Impacts: Geopolitical Events and Climate Change**  
*Mark Cocker*
- 
- 4:00 pm – 4:15 pm **Hidden Byproduct Critical Element Supply Within Existing Mining Value Chains: Assessing the Tellurium Potential of the Australian Base and Precious Metals Sector**  
*Brian McNulty*
- 
- 4:15 pm – 4:30 pm **A Workflow to Assess the Critical Mineral Potential of Tailings: Case Study from the Red Dog Mine in Northwest Alaska, USA**  
*Nina Zaronikola*
- 
- 4:30 pm – 4:45 pm **A Mineralogical and Geochemical Study of Energy Critical Metals in the Carbonate-Hosted Zn-Pb Mine Tailings, Ireland**  
*Lingli Zhou*
- 
- 4:45 pm – 5:00 pm **Improved Measurement for Processing of Critical Minerals**  
*Henry Kurth*



**Day 3 – Tuesday, August 30, 2022 (Continued)****In-Person Speed Talks Session 3***Chair: Francisco de Azevedo*

- |                   |  |
|-------------------|--|
| 3:36 pm – 3:41 pm | <b>VMS Targeting Challenges: Rethinking the World-class IPB Province</b><br><i>Filipa Luz</i>  |
| 3:41 pm – 3:46 pm | <b>Timing of Orogenic Gold-forming Events Related to the Tectonic Evolution of California</b><br><i>Ryan Taylor</i>  |
| 3:46 pm – 3:51 pm | <b>Nature and Paragenesis of Copper Mineralization of the Viscaria Property, Kiruna District, Northern Sweden</b><br><i>Koray Tasbicen (Student)</i>             |
| 3:51 pm – 3:56 pm | <b>The Importance of Bi-Te Nanoparticles in the Remobilization of Polymetallic (Au-Ag-Te-Bi) Orogenic Gold Mineralization</b><br><i>Michael Herzog (Student)</i> |
| 3:56 pm – 4:01 pm | <b>Element Fluxes During Alteration in High-sulfidation Epithermal Systems</b><br><i>Ethan Tonks (Student)</i>   |
| 4:01 pm – 4:06 pm | <b>Age and Genesis of W-Mo-Cu Mineralization, Gold Hill, Utah</b><br><i>Nathan Carey (Student)</i>   |
| 4:06 pm – 4:11 pm | <b>Paragenetic Relationships at the Tuvatu Alkaline Epithermal Gold Deposit, Fiji</b><br><i>Daniel Schmidt (Student)</i>   |

- 4:11 pm - 4:16 pm **Unraveling Bulk-rock Compositional and Metamorphic Mineral Assemblage Zoning at the Laronde Penna Volcanogenic Massive Sulfide Deposit**  
*Miranda Lehman (Student)*
- 
- 4:16 pm - 4:21 pm **Importance of Foundational Petrology and Geochemistry for Evaluating Igneous Sources to Base Metal Mineralization in SW Ireland**  
*Paul Slezak*
- 
- 4:21 pm - 4:26 pm **The Source of Mineralization in Stratabound V Rich Deposits in the Yukon Territory, Canada: Evidence from V Isotopes**  
*Daniel Gregory*
- 
- 4:26 pm - 4:31 pm **Relationship of Magmatic and Ore-forming Processes in Andesitic Volcanoes - Example from the Štiavnica Stratovolcano, Slovakia**  
*Peter Koděra*

### Virtual Speed Talks

Virtual speed talks are available on demand via the virtual conference platform. We will have Q&A sessions with virtual speed talk presenters in Spatial Chat each day. Please consult the conference website for times and updates.

### Concluding Remarks

SEG 2023 London Announcement  
*Bob Foster*

## Virtual Speed Talks

Virtual speed talks are available on demand via the virtual conference platform. We will have Q&A sessions with virtual speed talk presenters in Spatial Chat each day. Please consult the conference website for times and updates.

### Vital Metals for the Next Century: From Exploration and Discovery Through Production

- STV1.01 Rionegro – a New Gold District in Colombia Including a Potential Witwatersrand and Carlin Type of Mineralization  
*Ricardo A. Valls Alvarez*
- STV1.02 Hydrothermal Alteration and Gold Occurrence at the Paleoproterozoic Piaba Orogenic Gold Deposit, Maranhão State, Brazil  
*Deniro F. Gonçalves Costa*
- STV1.03 The Carboniferous Shikebutai Iron Deposit in Western Tianshan, NW China: Petrology, Fe-O-C-Si Isotopes and Implications for Iron Pathways  
*Xiuqing Yang*
- STV1.04 Fe Isotope Systematics Indicate Magmatic Origin of the Per Geijer Iron Oxide-apatite Deposits in Northern Sweden  
*Patrick Krolop*
- STV1.06 Geology and Geochemistry of the Namucupo Gold Prospect, Mozambique Belt, Northeastern Mozambique: Insights from Ore Mineralogy, Fluid inclusions and Stable Isotopes  
*Manuel Nopeia*
- STV1.07 Karst-Hosted MVT Pb-Zn Deposits in Fold-thrust Systems: a Case Study of the Changdong Deposit in the Sanjiang Belt, China  
*Yingchao Liu*
- STV1.08 A Study of Mineralogy of Pyrite and Au Mineralization in Micro-Disseminated Gold Deposit in Southwest Guizhou, China  
*Huan Jiang*
- STV1.09 Preliminary Analysis of Zn and Ni Sulfides in Calcareous Black Shales, Puyango, Ecuador  
*John L. Manrique*
- STV1.10 Characterization of the Gold Deposits Associated with the Aurumina Granitic Suite and

- Ticunzal Formation in Northeastern Goias State, Central Brazil  
*Gabriel A. Barbosa Silva*
- STV1.11 A Potential Cu Skarn in the Huachocolpa District-Peru  
*Ivan E. Branes*
- STV1.12 Deciphering Conglomerate-host Gold Mineralisation in Moto Greenstone Belt, Congo Craton, DRC: Implication for Gold Exploration  
*Yann Mpaka Waku*
- STV1.13 Fault-surface Map Restorations of San Manuel-Kalamazoo: Reassessing the Tilting History  
*Juan F. Fajardo*
- STV1.14 Swirl Analysis of Alteration Assemblages Associated with Porphyry-hosted Gold Mineralization of the Yixingzhai Deposit in the Taihangshan District, North China Craton  
*Wen-Sheng Gao*
- STV1.15 New Constraints on the Formation of the Bolcana Au-Cu Porphyry System (Apuseni Mountains, Romania)  
*Sava Markovic*
- STV1.16 Genesis and Geochemistry of the Pahardiha-Rungikocha Gold Deposit in North Singhbhum Mobile Belt, Eastern India  
*Anmol Barla*
- STV1.17 The Geological Setting and Hydrothermal Alteration of the Tucano Gold Deposit, Guiana Shield, Brazil  
*Gabriel A. Soares*
- STV1.18 Ore Characteristics and Mineralogy of Fe-Sn Skarn Deposit in Batubesi Area, East Belitung, Western Indonesia  
*Wahyu V. Pratama*
- STV1.19 Characterization of Multiepisodic Events of Calcatreu Project, Rio Negro Province, Argentina  
*Matías S. Wernert*
- STV1.22 Geological Characterization of Auriferous Sulfide Within the Vempalle Dolostone, Cuddapah Supergroup, Southern India: Implication for Carlin Like Gold Occurrence  
*Ramesh C. Behera*
- STV1.22 He, Ar, S, and Pb Isotopic Constraints on the Origin of the Shuanghe Gold Deposit, China  
*FengChun Li*

- STV1.25 High Temperature (>800°C) Brine and Sulfide Melt Interaction During the Formation of Northern Bushveld Magmatic Sulfide Cu-Ni-PGE Deposits  
*Katie McFall*
- STV1.26 Epithermal Gold Mineralization Hosted in an Ophiolite: a Case Study of the Malabeg Prospect, Zambales Ophiolite Complex, Philippines  
*John Emmanuel S. Fungo*

### **Critical Minerals for Our Energy Future: Geology and Ore Deposit Models**

- STV2.01 Zircon and Monazite U-Pb Geochronology of Aquamarine-bearing Yamrang Pegmatite from Eastern Nepal Himalaya  
*Sushmita Bhandari*
- STV2.02 Mineralogy of Selected Samples from Hicks Dome, Hardin County, Illinois  
*Ann M. Hagni*
- STV2.03 Alteration Mineralogy of the Mapula Porphyry Copper Prospect in the Masara Gold District, Eastern Mindanao, Philippines  
*Juan Alex Vianne D. Amoroso*
- STV2.05 Skarn Mineralization in the Masara Gold District, Eastern Mindanao, Philippines  
*Ma Yna Rose Garcia*
- STV2.06 Exploration of Buried Li Brine Resources in Andean Salars, an Environmental-friendly Option for the Long-term Sustainable Production of Lithium Brine Resources  
*Héctor S. Sanchez Rioja*
- STV2.07 A Machine Learning-based Framework for Prospectivity Mapping of Critical Minerals  
*Ehsan Farahbakhsh*
- STV2.08 Alteration-mineralization and Whole Rock Geochemistry at the Deep Mill Level Zone (DMLZ) Ertsberg District, Papua  
*Utreck F. Rumbiak*
- STV2.09 Mantle-derived Volatile-rich Fluids Induced HREE Enrichment of Previously Differentiated Precambrian Crust to Form the Round Top Laccolith, Trans-Pecos, Texas  
*Tristan M. Childress*
- STV2.10 Geochemistry and Critical Metal Enrichment of the Dinapigue Nickel Laterite Deposit, Isabela, Philippines  
*Marco Alfredo Barrientos*

## **New Frontiers, Innovative Technologies, and Emerging Opportunities in Economic Geology**

- STV3.01 Contribution to the Magnesite Formation in the Tshipise Magnesite Field, Limpopo Province of South Africa  
*Lutendo D. Mutshaine*
- STV3.03 Paramount Ag - Au Potential under Barren Lithocaps in Mexico's Prolific Silver Belt  
*Jorge E. Ordonez*

## **Recent Innovations, Integrated Methods, and Case Studies**

- STV4.01 What Governed Au-Cu Mineralization Fertility of Magmatic Systems?: an Example from Yinan Au-Cu Skarn Deposits in Luxi District, North China Craton  
*Si-Yuan Li*
- STV4.03 Combined pXRF and FTIR assays for Exploration and Grade control; Examples from SGS Field Analytical Services and Testing (FAST) Toolbox  
*Alexander Seyfarth*
- STV4.04 XRF Core Scanning; Continuous Scanning Versus Point Scan: a Practical Review  
*Alexander Seyfarth*
- STV4.05 Unraveling the Geological History of the Fenelon Gold Deposit, Québec  
*Joy M. Carter*
- STV4.07 The Zaozigou Orogenic Gold-Antimony Deposit, West Qinling Orogen, China: Multiple Mineralization During Multiple Tectonic Evolutions  
*Kunfeng Qiu*
- STV4.08 Temporal Evolution of Copper Isotope in Dexing Porphyry Cu-Mo-Au Deposit, China, and Its Implications for Explorations and Cu Isotope Fractionation in Ore-forming Processes  
*Jiafeng He*
- STV4.10 Geochemical Data: a Critical Element in Geometallurgical Studies  
*Pim van Geffen*
- STV4.11 Development of Data Systems to Support Critical Mineral Research in New Mexico  
*Virginia T. McLemore*
- STV4.12 Automated Detection of Geophysical Features Characteristic of Carbonatites-Aalka-

line Ring Complexes  
*Malcolm Aranha*

STV4.13 Evaluation of Normalization Methods Applied to Short-Wavelength Infrared Spectroscopy Mineral Databases from Multiple Instruments and for Vectoring Analysis Exploration  
*Juan C. Paredes*

STV4.14 Hyperspectral Satellite Remote Sensing for District-scale Exploration in the Coastal Cordillera of Northern Chile: Alteration Mapping as a Vector to the Mineralization  
*Rita Chirico*

STV4.15 Drones for Remote and Autonomous Multi-sensor Mapping in Mineral Exploration  
*Sandra Lorenz*

## Exploring the Full Value Chain from Mine to Market

STV5.01 Potentially the Largest Unexploited 'Invisible Gold' Reserve Hosted in the Detrital Pyrites of Historical Witwatersrand Tailings Dumps  
*Steve J. Chingwaru*

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## INVITED/KEYNOTE SPEAKERS



**Edine Bakker** is a consulting geologist who has explored the European continent for base and precious metals over the past decade. She currently holds the role of Exploration Manager for Gold Line Resources, managing a portfolio of prospective gold assets in Fennoscandia. In previous positions, including at the Geological Survey of Sweden, Edine was involved in various EU-funded international raw materials research projects. She holds a B.Sc. degree from Vrije Universiteit (VU) Amsterdam and an M.Sc. degree from the Eidgenössische Technische Hochschule (ETH) Zürich.

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**Steve Beresford** is the co-creator of Exploration Radio with Ahmad Saleem. He is the generator of topics covered on the podcast and occasionally jumps in the interviewer's chair with Ahmad. Steve has been Chief Geoscientist for a number of mining companies and a professor at several universities in Australia. He is a systems thinker with an emphasis on mentoring change and building teams, often from scratch, with global experience in 64 countries and desktop experience in many more. Steve has worked in Ni, sediment-hosted Cu, VHMS, channel Fe, diamond, pegmatite Li, porphyry Cu, and HREE exploration, and his current passion is looking for supergiant deposits formed by interaction with salt.



## INVITED/KEYNOTE SPEAKERS (cont.)



**Maeve Boland** is a Geoscience Policy, Communications, and Public Affairs Specialist at the Irish Centre for Research in Applied Geosciences (iCRAG). She was Director of Geoscience Policy at the American Geosciences Institute from 2013 to 2018 and has extensive experience in both geoscience and policy in Ireland and the United States. She holds geology degrees from Trinity College Dublin and a Ph.D. from Colorado School of Mines.

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**Simon Bolster** is the Managing Director for Portable PPB. He is a geoscientist with over 30 years' experience in the gold exploration industry, specializing in regolith geochemistry and remote sensing. Previously, Simon served as a consulting geochemist for Newmont (global role) and a regolith specialist for Normandy Exploration and Anglo American (Africa). He has also held the position of Head of Exploration with a successful West African exploration company. Simon has worked in 30 countries on 5 continents, founded and operated a successful regolith geochemistry consulting company, undertaken numerous geochemical orientation surveys, and led regolith geochemistry training seminars and courses.



**Todd Chapman (Ret.)** recently concluded a 30-year diplomatic career, most recently as U.S. Ambassador to Brazil. Previously, he served as U.S. Ambassador to Ecuador, Acting Assistant Secretary of State for Political Military Affairs, and Charge

d'Affaires in Mozambique. Ambassador Chapman is a non-resident senior adviser at the Center for Strategic and International Studies in Washington DC, an advisory board member at the Krach Institute for Tech Diplomacy at Purdue University, and a non-resident fellow at the Colorado School of Mines' Payne Institute for Public Policy. He is also a business consultant serving on various corporate boards, including Skycatch, a geospatial data analytics company working with many of the largest mining companies in the world. He is based in Denver, Colorado.



**Brenton Crawford** studied structural geology and geophysics at Monash University. He then spent several years consulting in mine geology, structural geology, and geophysics for PGN Geoscience as well as working in a variety of geologic and geophysical

roles, predominantly in exploration. Brenton has also worked as a geophysicist and data scientist for MMG Exploration in nickel, copper, and zinc exploration and project generation. In 2015, he co-founded Solve Geosolutions, Australia's first exploration and mining-focused data science consultancy, and in 2019, he co-founded Datarock, a computer vision technology company geared at building productionized image and video analysis solutions for exploration and mining. Brenton currently serves as Datarock's Chief Operating Officer.

## INVITED/KEYNOTE SPEAKERS (cont.)



**Max Frenzel** leads the Geometallurgy and Economic Geology Group at the Helmholtz-Institute Freiberg for Resource Technology. He obtained an M.Sci. degree from the University of Cambridge in 2012, followed by a Ph.D. degree from TU Bergakademie Freiberg in

2016, and a postdoctoral position at the University of Adelaide in 2017–2018. His research focuses on different aspects of the mineralogy, geochemistry, and texture of base metal ores and how these affect mineral processing operations. He also works on the modeling of metal supply chains to better understand future availability issues.

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**Sally Goodman** is Vice-President of Generative Exploration for Newmont, spearheading the drive to discovery across the company's global portfolio of early-stage gold exploration projects. She has held management positions with Newmont, Goldcorp, and Atlantic Gold, and traveled globally as a consultant in structural geology with SRK Consulting. Prior to that, she held various lecturing and research posts in universities in Canada and the UK. Sally has a Ph.D. in economic geology and an M.Sc. in mineral exploration from the Royal School of Mines, London (UK), and a B.Sc. in geological sciences from Leeds University (UK).

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**Jane Hammarstrom** is a research geologist with the Geology, Energy and Minerals Science Center at the United States Geological Survey in Reston, Virginia. She holds a B.S. in geology from George Washington University and an M.S. in geology from Virginia Polytechnic Institute and State University. Her research focuses on mineral resource assessment, mineralogy of mine waste, and most recently, critical minerals as part of the Earth Mapping Resources Initiative. Jane is a recipient of the U.S. Department of the Interior Distinguished Service Award and an associate editor for *Ore Geology Reviews*. She is a past president of the Geological Society of Washington and a member of the Society of Economic Geologists, the Geological Society of America, and the Mineralogical Society of America.

## INVITED/KEYNOTE SPEAKERS (cont.)



**Murray Hitzman** is a Science Foundation Ireland Professor in the School of Earth Sciences, University College Dublin, and Director of the Science Foundation Ireland Research Centre in Applied Geosciences (iCrag). He previously served as Associate Director for Energy and Minerals at the U.S. Geological Survey, Charles Fogarty Professor of Economic Geology at Colorado School of Mines, a policy analyst in the White House Office of Science and Technology Policy and the U.S. Senate, and an exploration geologist conducting mineral exploration worldwide. Hitzman has B.A. degrees in anthropology and geology from Dartmouth College, an M.S. in geology from the University of Washington, and a Ph.D. in geology from Stanford University.

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**Elizabeth Holley**, the 2022 SEG Distinguished Lecturer, has 15 years of experience in economic geology and mining geology, including industry project management and academic research. She is currently an associate professor at Colorado School of Mines, teaching courses and advising graduate students on geologic aspects of mineral exploration and mine development. Her specialties include expertise in a range of geologic environments and mineral deposit types, including epithermal Au-Ag systems, gold in the Guyana shield, and Carlin-type deposits. Elizabeth aided in Underworld Resources' discovery of the White Gold deposit, Yukon, and she developed new methods for the detection and characterization of dissolving sulfide minerals in aqueous environments. She has also designed and taught undergraduate and graduate courses in environmental science, geology, and mineral exploration.



**Shawn Hood** is a professional geologist with more than 17 years of global experience. He is the Chief Technology Officer for GoldSpot Discoveries Corp., a technology company that creates and applies artificial intelligence, data sciences, and field data collection methods

to discover mineral deposits more quickly, efficiently, and with reduced cost. Previously, Shawn has worked globally in exploration and mining roles, and he maintains an external researcher position at the CODES Centre of Ore Deposit and Earth Sciences in Tasmania to lecture and publish on the subject of AI in mineral exploration. He received the SEG Graduate Student Fellowship in 2009 and holds Bachelor of Science (Hons), Master of Science, and Doctor of Philosophy degrees in geology.

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**Kurt House** is the CEO of KoBold Metals, an entrepreneur who works at the interface of technology and natural resources, and an adjunct professor in Stanford University's Energy Resources Engineering Department. He previously founded a carbon sequestration and enhanced oil recovery business as well

as a direct investment platform to acquire North American natural gas assets. Kurt was a KAUST Research Fellow at MIT, where he studied the chemistry and physics of CO<sub>2</sub> capture and storage. He received his Ph.D. from Harvard University in earth and planetary science for similar work and his B.A. in physics from the Claremont Colleges. Kurt has also worked in private equity and corporate advising for Bain & Company.

## INVITED/KEYNOTE SPEAKERS (cont.)



**Simon Jowitt** is currently an associate professor of economic geology at the University of Nevada, Las Vegas. His research focuses on the use of geochemistry to unravel geologic and mineralizing processes, mineral economics, global metal resources and security of supply of the critical elements, and the “economic” side of economic geology. Simon also studies the environmental impact of mining and the potential uses of mining and other wastes for metal production and carbon sequestration. He has published more than 95 scientific papers and peer-reviewed book chapters since 2010, is currently Vice-President for Student Affairs for the Society of Economic Geologists (SEG), and was the recipient of the SEG’s Waldemar Lindgren Award in 2014.

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**Robert Kaemba** is Exploration Manager with First Quantum Minerals Ltd., leading a multi-disciplinary team in the sediment-hosted copper search space. He holds a Bachelor of Science (Hons) degree in applied geology from the University of Leicester (2007) and is a recipient of the Institute of Materials, Minerals & Mining (IOM3, UK) Award. He also completed a High Impact Leadership (HIL) Certification with the University of Cambridge in 2020. Rob manages sediment-hosted copper grassroots, brownfield, and advanced-stage exploration projects. He has an interest in initiatives that may improve stakeholder engagement to foster success in obtaining social license to operate.



**Peter Megaw** is a consulting exploration geologist, President of IMDEX/Cascabel, and co-founder of Minera Cascabel, MAG Silver, and Minaurum Gold. He has studied and published on the carbonate replacement deposits and epithermal vein deposits of

Mexico for decades and is a frequent speaker at international academic and technical symposia, often presenting in Spanish. He and his team are credited with significant discoveries at Juanicipio-Fresnillo, Zacatecas; Platosa, Durango; and Cinco de Mayo-Pozo Seco, Chihuahua. Peter received the Carnegie Mineralogical Medal in 2009, the Society of Mining Engineers Robert M. Dreyer Award in Applied Economic Geology in 2012, and the Prospectors and Developers Association of Canada Thayer Lindsley Award, based on his signal discoveries in Mexico, in 2017.

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**Stephanie Mills** is a senior economic geologist with the Utah Geological Survey. Stephanie received her B.S. Honors from the University of Texas at Austin, and after receiving her Ph.D. from Monash University in Australia, she worked several years in

exploration before joining the Survey in 2019. Her research focuses on magmatic-hydrothermal mineral systems and developing field-based exploration techniques. Stephanie is a registered professional geologist and a Fellow of the SEG.



## INVITED/KEYNOTE SPEAKERS (cont.)



**Nedal Nassar**, Chief of Minerals Intelligence Research at the USGS, quantifies the stocks and flows of mineral commodities, develops supply and demand scenarios, and assesses the mineral commodity supply risks to the U.S. economy.

He serves on the U.S. National Science and Technology Council's Critical Minerals Subcommittee, the Executive Committee of the USGS Council of Senior Science Advisors, and advisory boards of various international projects. In 2019, he was awarded the Presidential Early Career Award for Scientists and Engineers. He holds Ph.D., M.Phil., and M.E.Sc. degrees from Yale University, an M.B.A. from Cornell University, and a B.Ch.E. from the University of Minnesota.

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**Robert North** has more than 40 years of experience in geology and mineralogy, including 10 years in the Democratic Republic of the Congo. He began his career in 1978 as Mineralogist for the New Mexico Bureau of Mines in Socorro. Bob left the Bureau in

1988 to work for Phelps Dodge at Morenci and later as Chief Geologist at the Chino mine. Bob transferred to PD Exploration in Oro Valley, Arizona, in 2006, ultimately leading to his assignment to Tenke Fungurume Mining in 2008 for Freeport McMoRan. Bob holds a B.S. in geology from Illinois State University and an M.S. from Northern Illinois University.



**Matthew Pearson** is a serial entrepreneur with a passion for space technology. Having co-founded companies including Fleet Space Technologies and Alauda, Matthew is an expert in bringing new and innovative technologies to market,

startup management, systems development, and online product development. His mission at Fleet is to create breakthrough tools for explorers of new worlds, including satellite-driven automated and non-invasive exploration for mineral and material deposits.

Our people discover the products that make our modern lives possible



## INVITED/KEYNOTE SPEAKERS (cont.)



**Jeff Pontius** is the SEG Industry Speaker for this conference. Jeff has worked in the mining industry exploration sector for more than 40 years. He led the discovery and development work on six North American gold deposits during his career, including

the world-class discoveries at Cripple Creek in Colorado and Livengood in Alaska, culminating in the discovery and development of over 45 million ounces of gold. Jeff was the founder, CEO, President, and Director of Corvus Gold Inc. until its acquisition by AngloGold Ashanti earlier this year. Prior to this he was the founder and CEO of International Tower Hill Mine, North American Exploration Manager for AngloGold Ashanti, and he worked in senior management positions with Minorco/Anglo American and Nerco Minerals Company. Jeff has also been involved in a number of junior resource start-up companies over the past two decades. He received the Colin Spence award for excellence in global mineral exploration in 2011 and the Robert M. Dreyer award for a career of exceptional exploration leadership. He holds a master's degree in economic geology from the University of Idaho, School of Mines, a B.Sc. degree in environmental science from Huxley College, and a B.Sc. degree in geology from Western Washington University.



**Rick Rule** is the President and CEO of Rule Investment Media. Rick began his career 47 years ago, in 1974, in the securities business and has been involved in it ever since. He is known for his expertise in many resource sectors, including agriculture, alternative energy, forestry, oil and gas, mining, and water. Mr. Rule is actively engaged in private placement markets through originating and participating in hundreds of debt and equity transactions.

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**Ahmad Saleem** co-hosts *Exploration Radio*, a podcast on the past, present, and future of mining and exploration. He is currently Director of Business Development for VerAI, a project generator utilizing the latest in artificial intelligence technology. His professional career includes time in technical roles on exploration and mining projects, as an analyst in a private equity firm, and as Exploration Manager for a junior exploration company. He has been involved as a founder or early member of various technology startups and currently runs a data analytics consultancy focusing on developing data mining techniques. Ahmad is an ardent advocate of utilizing modern, innovative techniques to explore new and mature geologic terrains. He is also passionate about the role of softer skills in exploration success.

## INVITED/KEYNOTE SPEAKERS (cont.)



**Anders Sand** has about 15 years' experience in senior academic and corporate positions in the mining industry, with the main field of expertise being in mineral processing technology. At Boliden, he has held positions as Process Manager, Manager of the Process Technology R&D Programme and, currently, Research Manager. He holds a D.Sc. degree in Chemical Engineering from Åbo Akademi University, Finland, and is Docent in Mineral Processing at Luleå University of Technology, Sweden.

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**Douglas Silver** received his M.S. in Economic Geology from the University of Arizona and began his career for Anaconda Copper as one of the discoverers of the Silver Creek molybdenum deposit in Colorado. Doug later became the head of Investor Relations for Bond International Gold. After Bond, his personal consulting company, Balfour Holdings, provided him 20 years of senior management consulting. In 2005, Douglas put together the team that built International Royalty Corporation and grew it into the fourth largest royalty company. He sold it for a handsome profit in 2011 and spent the last 10 years of his career as a senior member of Orion Resource Partners. In 2018, Douglas was inducted into the U.S. National Mining Hall of Fame.



**Isaac Simon** is a Ph.D. student at Colorado School of Mines with professional experience in Cu production and exploration of base and precious metals. His research has involved geochemical methods including U-Pb age dating of syndeformational mineral growth, origin and ore-forming conditions of hydrothermal pentlandite-quartz veins, and hydrogeochemical signatures of mining. Isaac is currently doing research on geochemical processes leading to contamination from artisanal and small-scale mining in Arequipa, Peru. His work is part of the Center for Mining Sustainability research group—a collaboration between the Colorado School of Mines and the Universidad Nacional de San Agustín de Arequipa. Projects through the Center for Mining Sustainability focus on managing mining practices sustainably while supporting local economies and reducing environmental impacts in southern Peru.

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## INVITED/KEYNOTE SPEAKERS (cont.)



**Sam Thiele** is a postdoctoral researcher at Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Freiberg, Germany. He holds a Ph.D. in geology and has 15 years of programming experience. His areas of expertise include exploration targeting, data visualization, and GIS analysis and development. Sam is particularly interested in the challenges earth scientists face when integrating and synthesizing diverse and multiscale datasets. He has a broad range of research interests and skills, but especially enjoys applying new mapping technologies such as unmanned aerial vehicles ("drones") to gain insight into volcanic and geothermal environments in a more sophisticated way.

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**John Tumazos** holds a B.S. in management science and economics (1978) and an M.S. in industrial administration (1979) from Carnegie-Mellon University. Over the course of his career, he has worked for a variety of organizations, including Oppenheimer & Co., Inc., Donaldson, Lufkin, & Jenrette, and Texas Rare Earth Resources. Currently, Mr. Tumazos operates John Tumazos Very Independent Research LLC, serving as a financial advisor to nine emerging gold, uranium, PGM, rare earth and base metals companies, among other clients. He was inducted into Institutional Investor's All-American Research Team "Hall of Fame" in December 2011. In his spare time, Mr. Tumazos enjoys athletics and outdoor activities, having completed 84 triathlons since 1994.



**Frances Wall** specializes in technology raw materials, including rare earth elements and lithium, with interests in geology, processing, responsible sourcing, and circular economy. She is principal investigator for the Met4Tech circular economy centre and is/has recently been involved in various international consortium research projects involving exploration for critical metals ([sosrare.org](http://sosrare.org), [alkcarb.org](http://alkcarb.org), [greenpeg.eu](http://greenpeg.eu), [lithiumfuture.org](http://lithiumfuture.org)), as well as regional development of mineral resources. Frances was named one of the 100 Global Inspirational Women in Mining 2016 and was awarded the William Smith Medal of the Geological Society of London for applied and economic aspects of geology in 2019.





## Posters

Posters will be on display throughout the conference in the Exhibit area, with a dedicated poster reception from 5:00 to 6:00 pm Monday.

Titles and authors of posters are listed below, according to theme.

### **Vital Metals for the Next Century: From Exploration and Discovery Through Production**

- P1.01 Rare Earth Element Mobilization and Enrichment in Alkaline Complexes  
*Dennis O. Achoki*
- P1.02 Morphotextural and Chemical Analysis of Proximal Gold Placers and Epithermal Primary Sources: the Serra Dourada – Bananal Deposit (Aguapeí Belt, Brazil)  
*Kelvin D. Alves*
- P1.03 A Study of Philipsburg's Polymetallic Lode Deposits, Granite County, Montana  
*Celine M. Beaucamp*
- P1.04 Structural Control for the Hosting of Gladys Belt in the Huachocolpa Mining District  
*Ivan E. Branes*
- P1.05 Fresh Interpretation of PGE-Ni-Cu-Co Mineralisation in the Northern Limb of the Bushveld Complex  
*Kate R. Canham*
- P1.07 Geological and Geochemical Characterization of the Chifumbazi Gold Prospect, Irumide Belt, Tete Province, Northern Mozambique  
*Euclesia P. Cossa*
- P1.08 The Nazca-Ocoña Metallogenetic Belt, Arequipa, Peru: Geological Characteristics of Quartz-calcite-sulfide Veins  
*Jorge Crespo*
- P1.12 Sediment-hosted Gold Mineralization in the Gegalaw Deposit, Central Myanmar  
*June B. Born*

- P1.13 Rare Earth Elements (REE) Potential in the Cornudas Mountains, Southern New Mexico  
*Virginia T. McLemore*
- P1.14 Characterization of Gold from the Liberty Area, Washington  
*Timothy A. Miller*
- P1.15 Mineralogical Evolution and Gold-Silver Zonation in the Segovia-Remedios Mining District, Colombia  
*Ricardo S. Molano*
- P1.17 The Metallogensis of the Orogenic Gold Fields in the Karagwe-Ankole Belt in Central Africa:” a Systematic Review of the Current Understanding”  
*Rub’son H. N’nahano*
- P1.18 Distinctive Chemical Composition of Gold-Ore-Forming Magmas  
*Carolina Nogueira Mafra*
- P1.19 New Investigations of the REE-Nb Carbonatite Deposits of Southern Ravalli County, Montana, USA  
*Sarah Risedorf*
- P1.20 Exploration Model for Base and Precious Metals in the Eastern Gavião Block, São Francisco Craton, NE Brazil: Geochemical and Tectonic Constraints  
*Ricardo R. Spreafico*
- P1.21 Depositional History and Gold Potential of the Ament Bay Assemblage in the Sturgeon Lake Greenstone Belt, Northwestern Ontario, Canada  
*Michael Tamosauskas*
- P1.22 Underrated and Overlooked: the Magmatic–hydrothermal Transition Recorded by Trace Elements-in-Quartz  
*Leonidas C. Vonopartis*
- P1.23 Textural Characteristics of Adularia Dendrites in Banded Quartz Veins from the Midas Deposit, Nevada  
*Lauren R. Zeeck*
- P1.24 Study and Discovery of Gold Bearing Conglomerates in the North China Craton  
*Baojin Zhao*

- P1.25 The Milingui Iron Ore Deposit in Tchibanga,  
Gabon  
*Baojin Zhao*

## **Critical Minerals for Our Energy Future: Geology and Ore Deposit Models**

- P2.01 An Experimental Study of Tellurium Solubility  
in Water Vapor Between 150 - 300 °C:  
Implications for Ore Formation  
*Jonathan R. Adams*
- P2.02 Solubility of Cu, Ag and Au in Magmatic  
Sulfur-bearing Fluids as a Function of Oxygen  
Fugacity  
*Alice Alex*
- P2.03 Mineralogy and Trace Elements Chemistry of  
Quartz Vein from Tsunheg Tungsten Deposit  
in Western Mongolia  
*Baatar Amitan*
- P2.04 Airborne Magnetic and Radiometric Data  
Provide Insights to Alkaline Intrusive  
Complexes and Associated REE and Thorium  
Resources in the Wet Mountains, Colorado  
*Eric D. Anderson*
- P2.05 Translithospheric Tracers of Ni-Cu-Co-PGE  
Mineralisation: a Geochemical Approach  
*Blanks, Daryl E.*
- P2.07 Lead Isotope and Fluid Inclusion  
Investigations of the Hicks Dome Critical  
Mineral Resource, Illinois-Kentucky Fluorspar  
District, USA  
*Mitchell M. Bennett*
- P2.08 Exploration and Mining Industry Feedback on  
the USGS Earth Mapping Resources Initiative  
(EarthMRI)  
*Andrew R. Giebel*
- P2.09 Defining Volcanic Stratigraphy and Syn-  
volcanic Intrusions at the Lynne Zn-Pb-Cu  
Deposit, Wisconsin, USA  
*Lillian N. Glodowski*

- P2.10 Onganja, Namibia: to Be or Not to Be an IOCG?  
*Matthew P. Hales*
- P2.11 Towards a Genetic Model for the Cu-(Te-Au-Ni-PGE) Sulfide Deposits of the Curaçá Valley, Brazil  
*David A. Holwell*
- P2.12 Geochemistry and Genesis of the Manganese Deposits in Mankwadzi Southern Kibi-Wenniba Belt, Ghana  
*Kwabina Ibrahim*
- P2.13 Mineralogical Sequestration of Tellurium at the Perseverance Volcanogenic Massive Sulfide Deposit, Quebec, Canada  
*Filip Kasprowicz*
- P2.14 Nickel Mineralogy of the Historic Callenberg Ni-Laterite District, Saxony, Germany  
*Max Frenzel*
- P2.15 Using Ore Petrography and Geochemical Mass Balance to Constrain the Hydrothermal Environment at the Paleoproterozoic Flambeau Cu-Zn-Au Deposit, Wisconsin, USA  
*Robert W. Lodge*
- P2.16 Structural and Kinematic Analysis of Alkaline Dikes and Mineralized Veins in the Wet Mountains, Colorado: Connecting Rare Earth Element Mineralization to Cambrian Rifting  
*Benjamin P. Magnin*
- P2.17 The Lanthanide Tetrad Effect as an Exploration Tool for Granite-related Rare Metal Ore Systems: Examples from Iberian Variscides  
*Ivo Martins*
- P2.19 Litho-geochemical Vectors and Mineral Paragenesis of Hydrothermal REE-Bearing Fluorite Veins and Breccias in the Gallinas Mountains, New Mexico  
*Evan J. Owen*
- P2.20 Presence of In, Ga and Ge in the Epithermal High Sulfidation Deposit of La Mejicana Mine, Famamtina District, NW Argentina  
*Morena L. Pagola*

- P2.21 Characterization of the Footprint of Hydrothermal Ore Forming Processes Through Trace Metal Signatures in Fluorite in the Cooke's Peak Pb-Zn-Ag-F District, New Mexico  
*Cody D. Schwenk*
- P2.22 Magmatic Controls on Platreef Stratigraphy, Northern Limb of the Bushveld Complex, South Africa  
*Erin S. Thompson*
- P2.23 Using La-Icp-MS Trace-element Sulphide Mapping to Delineate Multiphase Co-Cu Mineralization in the Kakanda Deposits, Central African Copperbelt DRC  
*Helen Twigg*

### **Exploring the Full Value Chain from Mine to Market**

- P3.02 Trace Elements and U-Pb Dating of Zircon from the Humpa Leu East Porphyry Cu-Au Prospect, Sumbawa Island, Indonesia: Implications for Petrogenesis and Magma Fertility  
*Fadlin, Fadlin*
- P3.03 In Situ Rb-Sr Dating of Hydrothermal Mineral Deposits by LA-ICP-MS/MS Huang, Shiqiang
- P3.04 Remote Sensing of Gudjareti- Khachkovi Gold Ore Field. Adjara-Trialeti Folded Zone, Lesser Caucasus (Georgia)  
*Giorgi Mindaashvili*
- P3.06 A Study of the Diatomite Deposit in Shengzhou of Eastern Zhejiang Province, China  
*Xu Jia*

### **Recent Innovations, Integrated Methods, and Case Studies**

- P5.02 Integration of Magnetic and Mineral Occurrence Datasets Over Az, Co, Nm, and Ut: Implications for Archean-Cambrian Basement Control on Jurassic-Eocene Mineralization

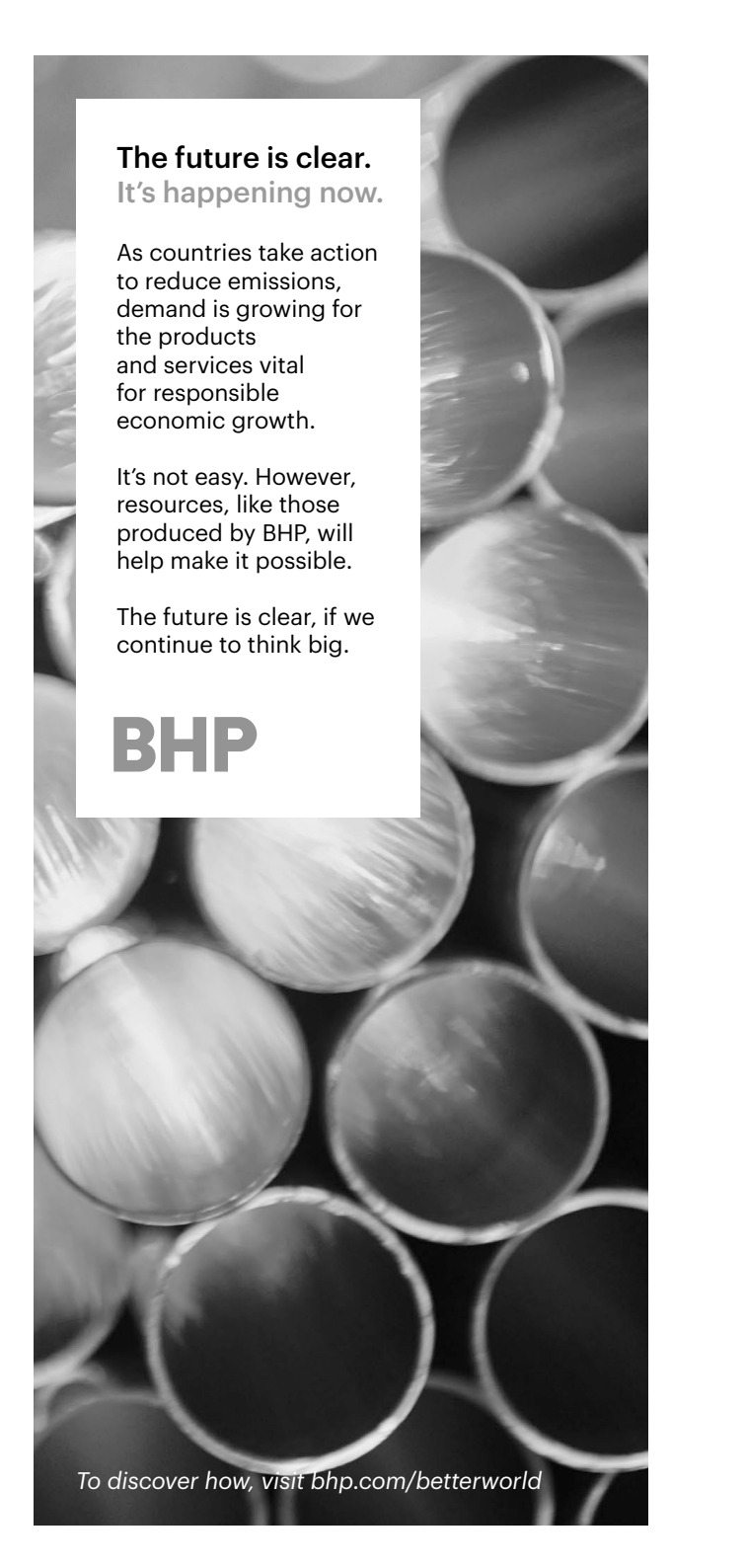
*Robert D. Charnock*

- P5.04 Gold Mineralization at the Tuvatu Alkalic Epithermal Au-Ag Telluride Deposit, Viti Levu, Fiji  
*Jake A. Jefferson*
- P5.07 The Magmatic Duration of Climax-type Porphyry Mo Systems  
*Joshua M. Rosera*
- P5.08 Geoenvironmental Properties of the Quebrada Blanca Deposit Waste Rock Using Hyperspectral Mineralogy  
*Enrique Saez Salgado*
- P5.09 Alteration Targeting and Geophysical Exploration of the Little Hatchet Mountains, New Mexico  
*Kenneth Singh*
- P5.10 New U/Pb Geochronology from the Proterozoic Penokean Orogen, Wisconsin: Implications for VMS Metallogeny  
*Evan M. Weber*
- P5.11 Carbonate-Apatite in the Southwestern Ordos Basin, China: Link with Life and Its Significance  
*Chao Zhang*
- P5.12 Framboidal Pyrite Formation and Its Significance in the Southwestern Ordos Basin, China  
*Chao Zhang*



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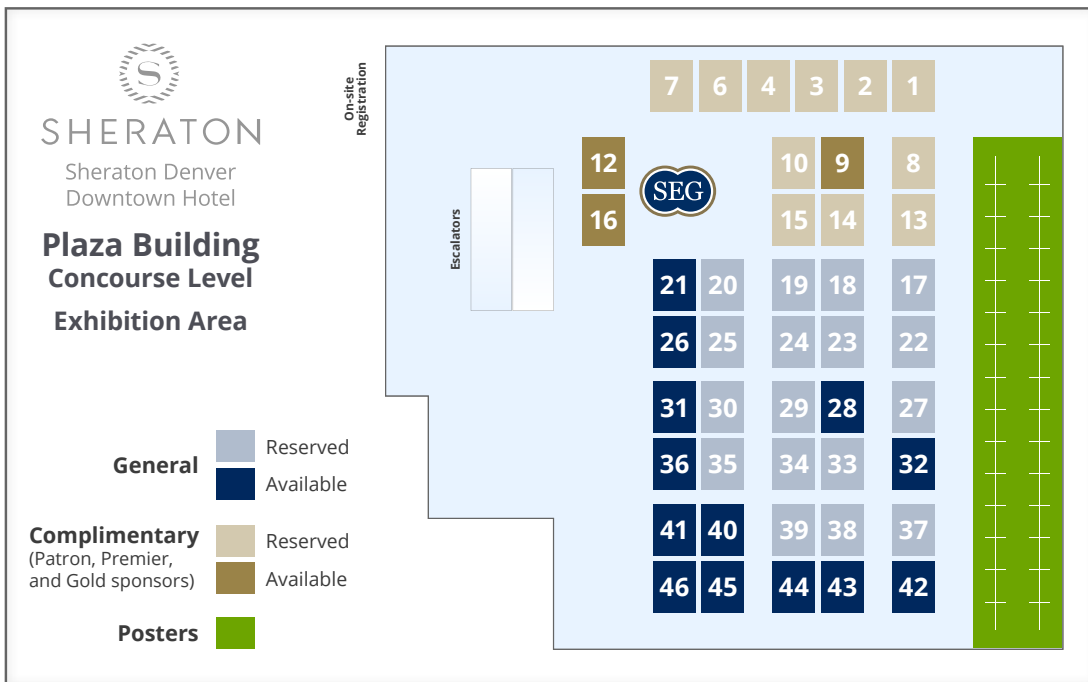
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