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IAMG Newsletter

Official Newsletter of the International Association for Mathematical Geosciences

Contents

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From the Editor

It was great seeing everyone at the 2025 IAMG annual conference in Zhuhai. Congratulations to the organisers for arranging a very successful conference. The group photo is included below, and some highlighs are on page 7.

Please consider submitting a session proposal or abstract to IAMG2026, wich will be on in August in Montreal, Canada. More details are on page 4.

A ballot for approval of a series of changes in the IAMG bylaws is being held. Raimon Delgado has explained the need for these on page 3. All IAMG members are encouraged to vote.

Katie Silversides

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Below: Attendees of the 2025 IAMG Annual Conference in Zhuhai, China

The mission of the IAMG is to promote, worldwide, the advancement of mathematics, statistics and informatics in the Geosciences

International Association for Mathematical Geosciences

Official address: I4601 E Douglas Ave STE 150
Wichita KS 67218-1032, USA
Mailing Address: 10580 N McCarran Blvd #115-173
Reno, NV. 89503, USA
E-mail: support@iamgmembers.org
Website: IAMG.org

Officers of the Executive Committee

President: **Raimon Tolosana Delgado**
Dept Modelling and Valuation
Helmholtz Institute Freiberg for Resource Technology
Helmholtz-Zentrum Dresden-Rossendorf
Email: r.tolosana@hzdr.de

Vice President: **Dionissios Hristopoulos**
School of Electrical and Computer Engineering
Technical University of Crete
Email: dchristopoulos@tuc.gr

Secretary General: **Ute Mueller**
Edith Cowan University, Joondalup WA 6027
Email: u.mueller@ecu.edu.au

Treasurer: **Tim Coburn**
Colorado State University, USA
Email: coburnt51@yahoo.com

Other Voting Council Members

Past President: **Peter Dowd**
School of Chemical Engineering,
University of Adelaide, Australia
Email: peter.dowd@adelaide.edu.au

Special IGC Councilor: **Jeff Boisvert (Canada)**
Civil and Environmental Engineering Dept
Faculty of Engineering
University of Alberta, Canada
Email: jbb@ualberta.ca

Councilors

Caterina Gozzi
Department of Earth Sciences
University of Florence, Florence, Italy
Email: caterina.gozzi@unifi.it

Guillaume Pirot
School of Earth Sciences
University of Western Australia
Email: guillaume.pirot@uwa.edu.au

Karel Hron
Palacky University, Olomouc,
Czech Republic
Email: hronk@seznam.cz

Jörg Benndorf
TU Bergakademie Freiberg
Institut für Markscheidewesen und Geodäsie
Freiberg, Germany
Email: Joerg.Benndorf@mabb.tu-freiberg.de

Mario E. Rossi
GeoSystems International, Inc.
Florida, USA
Email: mrossi@geosysint.com

Xavier Emery
Universidad de Chile
Santiago, Chile
Email: xemery@ing.uchile.cl

Editors

Mathematical Geosciences **Roussos Dimitrakopoulos**
Department of Mining, Metals and Materials Engineering,
McGill University, Montreal H3A 2A7, Canada
E-mail: roussos.dimitrakopoulos@mcgill.ca

Computers & Geosciences **Pauline Collon**
University of Lorraine National Graduate School of Geology,
Vandœuvre-les-Nancy, France
E-mail: pauline.collon@univ-lorraine.fr

Centro de Recursos Naturais e Ambiente, **Leonardo Azevedo**
Instituto Superior Técnico
Universidade de Lisboa, Portugal
Email: leonardo.azevedo@tecnico.ulisboa.pt

Edith Cowan University, **Ute Mueller**
Joondalup, WA, Australia
Email: u.mueller@ecu.edu.au

Natural Resources Research **John Carranza**
University of KwaZulu-Natal,
Durban, South Africa
Email: ejmcarranza@gmail.com

Applied Computing and Geosciences **Marshall Ma**
Computer Science Department, University of Idaho, USA
Email: max@uidaho.edu

MOX - Dept. of Mathematics, **Alessandra Menafoglio**
Politecnico di Milano, Piazza Leonardo da Vinci, Milan – Italy
Email: alessandra.menafoglio@polimi.it

IAMG Newsletter and Website **Katherine Silversides**
Datarock, Australia
E-mail: newsletter@iamg.org

Committee Chairs

Awards Committee: **Shaunna Morrison**
Earth and Planetary Sciences Department
Rutgers University New Brunswick, United States,
E-mail: s.morrison@rutgers.edu

Lectures Committee: **Sandra de Iaco**
Department of Economics, University of Salento, Italy
E-mail: sandra.deiaco@unisalento.it

Meetings Committee: **Jaime Gomez-Hernandez**
School of Civil Engineering, Polytechnic University of Valencia,
Spain
Email: support@iamgmembers.org

Outreach Committee: **Dionissios Christopoulos (Greece)**
School of Electrical and Computer Engineering
Technical University of Crete, Greece
E-mail: dchristopoulos@tuc.gr

Students Affairs Committee: **Enamundram Chandrasekhar**
Department of Earth Sciences
Indian Institute of Technology Bombay
E-mail: esekhar@iitb.ac.in

Archivist

Eric C Grunsky
E-mail: egrunsky@gmail.com

PRESIDENT'S FORUM

Dear IAMG members,

The new year is approaching fast and, with it, the need to renew our membership status. As usual, the Technical Secretariat will be sending renewal notices soon: you may have received them even before this letter reaches you. When you receive it, please, renew your membership... and even if you are a lifetime member, visit www.iamgmembers.org and just log in. This little step helps us keep track of who is still engaged in any sense. You may also take the opportunity to update your contact details. Indeed, we plan to include a modification in the membership databases from 2026 on, particularly affecting the status of all long-term members: if a member does not login at least once a year in any of the IAMG servers, their membership will be marked as dormant. As soon as they log in to www.iamgmembers.org or www.iamgconferences.org, their full membership will be reactivated automatically. The goal is to have a more accurate picture of the active membership, for instance to more fairly compute participation in elections and ballots.

Indeed, together with your membership renewal, you should also receive instructions to participate in the ballot for approval of a series of changes in our bylaws. I announced in this forum one year ago that this was going to be necessary to keep our statutory body up-to-date. This is a standard procedure: our constitution has been revised 17 times since our foundation in 1968. In this ballot, only changes to the bylaws are being voted on and will be approved if accepted by a simple majority of voting members, as marked in the bylaws. These are minor amendments to reflect the present working arrangements of the IAMG governance structure. You will find the details of the ammendments proposed in the ballot and in a separate information being currently sent. With a little bit more of discussion within the Council and the Committees we may propose a second ballot in due course to consider changes in the Statutes, which require two thirds of voting members to be approved.

Personally, I would like one such revision to the statutes to implement a means to enhance the preservation of know-how for the position and tasks of the Treasurer. Several options are on the table which we are still discussing. These include the creation of a new committee, the modification of the term of the Treasurer or the inclusion of the Past Treasurer as a member of the Council. If you want to share another idea with us or have a strong opinion about this topic, please do not hesitate to write to the Executive at executive@iamgmembers.org.

In the meantime, I am very glad to announce that we have a new Treasurer to replace Tim Coburn, who has repeatedly asked to be relieved of his duties. We all welcome Arja Jewbali as the IAMG Treasurer for the rest of this Council term. Arja is a long-standing IAMG member, with a PhD in Geostatistics from the University of Queensland and more than 20 years of experience in industry and academia. I wish her all he best and that she finds the tasks amenable. At the same time, I want to express my personal gratitude and, I am convinced, that of the present and the past Council to Tim Coburn and Sean McKenna for having steadied the ship of the IAMG finances. There is going to be a transition period in which all accounts and responsibility as IAMG representatives for matters of the US tax service passes to Arja.

Finally, I would like to ask everyone to keep an eye on the deadlines for the 2026 IAMG Annual Conference in Montréal in August. The abstract submission deadline is February 28th. This time the conference will take place in a hotel, with which the local committee has negotiated a room block. If you want to get a good deal and at the same time support the IAMG financial position, please book your hotel rooms following the instructions of the conference as soon as possible. Send abstracts with your best ideas. Come to Montréal!

Raimon Tolosana Delgado

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YouTube

The IAMG now has a YouTube channel! Presentations from past IAMG award winners have been uploaded where available.

https://www.youtube.com/@IAMG-mathgeo

IAMG is on LinkedIn, Twitter and Facebook!

Join the conversation using @IAMG_Math_Geo

Dear fellow (mathematical) geoscientists,

The 24th annual conference of the IAMG will take place in Montreal, Canada and it is our great honour to welcome you to Montreal in 2026.

We are looking forward to outstanding presentations and scientific discussions, along with social events, workshops, excursions and field trips. The thematic core of the conference will emphasize data-driven discovery along with Artificial Intelligence and cross-disciplinary approaches addressing Geoscientific Imperatives.

Montréal is a beautiful city renowned for its international flavour and inspiring diversity. Located on an island in the St. Lawrence River, it is home to approximately 1.8 million residents and the largest bilingual workforce in Canada. It is the largest French-speaking city outside France and a perfect blend of European energy and North American efficiency. It is one of the world's top convention cities with a unique urban ambiance with a friendly population, world-famous gastronomy and cultural diversity.

Hope to see you in Montreal Your IAMG2026 organizing team

News: IAMG2026 collaborating with International Union of Geodesy and Geophysics

As a new initiative, we welcome scientific cooperation with the Commission on Mathematical Geophysics (CMG) of IUGG (www.iugg.org). The IUGG is a world-renowned scientific organisation, established more than 100 years ago, which provides an umbrella for eight international scientific associations and six interdisciplinary commissions (one of which is CMG). The Union deals with scientific (physical, chemical, and mathematical) studies of the Earth and its environment in space. IAMG is an IUGG Affiliated Organisation, and there are clear synergies between the IAMG and the IUGG-CMG. At IAMG 2026 we plan to organise several sessions convened by IUGG-CMG members.

Important dates — Session submission extended until Jan. 04, 2026!

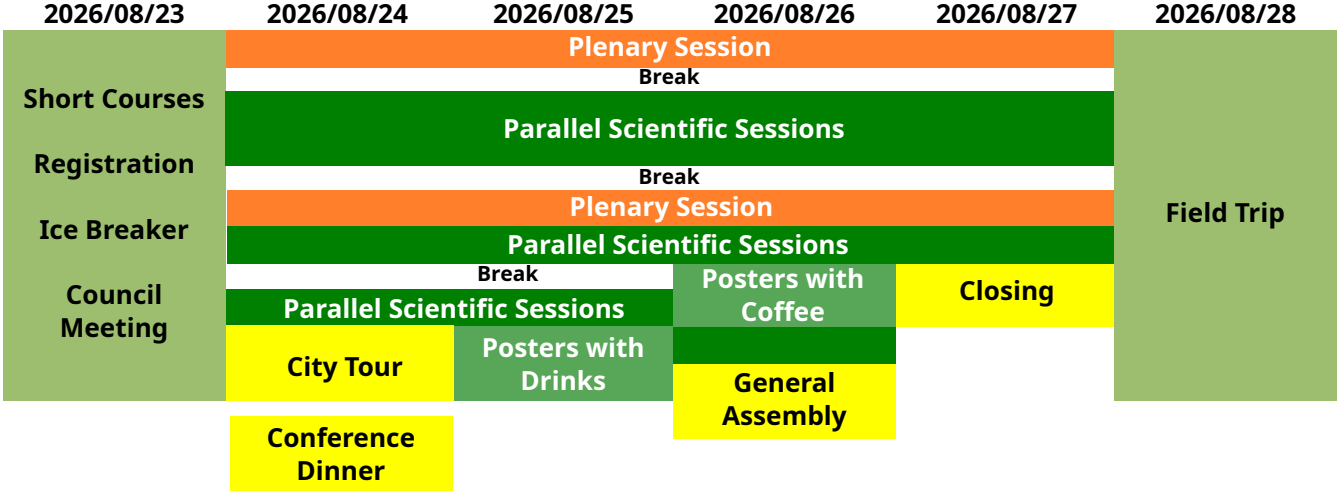
2026/01/16	Short abstract submission opens	2026/08/23	Short Courses, Registration, Ice-Breaker
2026/03/16	Short abstract submission deadline	2026/08/24-27	Scientific Sessions
2026/04/15	Acceptance notifications to authors	2026/08/28	Field trips
2026/05/15	Early bird registration deadline		

Abstract submission opens January 16, 2026!

We welcome contributions from all areas of Mathematical Geosciences and Geoinformatics either to one of our focal topical sessions or to one of the general conference themes around common methods and topics.

Please submit your abstract via the conference website with a title, a short abstract (up to 300 words) and an optional graphical abstract.

Program overview



Keytopics

+ Mathematical and Computational Methods for the Geosciences
+ Artificial Intelligence in Geosciences
+ Big Data and Cloud Computing
+ Developments in Machine Learning Techniques for Geoscience Applications
+ Uncertainty Modelling and Quantification in Applications
+ Developments in the Prediction of Extreme Geological Events
+ Real World Energy Challenges and Geomathematics
+ Geothermal Energy
+ Reservoir Engineering and Geological Carbon Storage Operations
+ Hydrology and Hydrogeology
+ Mining Geostatistics and Geometallurgy
+ Mathematical Geoscientific Contribution to Global Sustainable Development
+ Mineral prospectivity mapping and AI advances
+ Developments in machine learning techniques for geoscience applications
+ Spatio-temporal data analytics and modelling
+ Compositional Data in Geosciences
+ Computational Geophysics
+ Computational Geodynamics
+ Earth System Modeling
+ Environmental Geo-engineering
+ Geostatistics and New Simulation Methods
+ Modeling of Earth Resources and Energy Transition
+ Geotechnical Engineering
+ Planetary Geosciences
+ Data Assimilation in Diverse Environments
+ Education: Next Generation Mathematical Geoscientists

Suggested focal topical sessions per November 28

+ AI-driven Mineral Prospectivity Modeling **Emmanuel John Carranza, Renguang Zuo**
+ Computational methods for quantifying hydrocarbon resource potential and exploration risk **Jingdu Yu, Weihong Liu, Qian Zhang**
+ Big Data Mining & Artificial Intelligence in Solid Earth Science **Yongzhang Zhou, Marshall (Xiaogang) Ma, Hui Yang, Craig A. Knoblock**
+ Theories and Practices in AI for Geosciences **Marshall (Xiaogang) Ma, Tao Wen, Anirudh Prabhu**
+ Geoinformatics for Mineral Exploration: Integrated Spatial Intelligence and Target Generation **Mana Rahimi, Vesa Nykänen**
+ Sustainable advances and applications in the modelling and forecasting of complex spatial and/or temporal patterns **Xiao Xia Lang, Guillaume Pirot**
+ Intelligent Mineral Exploration: Data-Driven and AI-Empowered Decision-Making Under Uncertainty **Behnam Sadeghi, Eric Grunsky, David Zhen Yin, Wenlei Wang, Glen Nwaila**
+ Adaptive and Nonlinear Data Analysis Techniques for Characterizing the Complex Earth Systems **Enamundram Chandrasekhar, Sang-Mook Lee**
+ Mathematical Modelling and Machine Learning Applications in Early Warnings and Mitigation of Natural Hazards **Enamundram Chandrasekhar, T Hemalatha, Roberto Carniel, E Hari Chandana**
+ Advances in Quantitative Modelling of Earth Dynamics and its Manifestations **Alik Ismail-Zadeh, Alexandre Fournier , Oleg E. Melnik, Pavel Novák**
+ Advances in Analysis, Mathematical and Numerical Modelling in Atmosphere, Hydrology, and Sea-Ice Dynamics **Elisa Arnone, Elisa Mantelli, Leslie M. Smith**
+ Geometallurgy, geostatistics and stochastic decision making along the minerals value chain **K. Gerald van den Boogaart, Julian Ortiz, Jörg Benndorf, Raimon Tolosana Delgado**
+ Geological Process Modeling **Daniel Tetzlaff, Ana M. Sosa Paez**
+ Advances in Image Analysis and Machine Learning Algorithms for Quantitative Petrography: From Mineral Separates to Core Logging **Paul Bedard, Arnaud L. Back, Julien Maitre, Kevin Bouchard**

Suggested short courses

+ Mathematical Morphological (Spatial) Algorithms in Surfaces **B. S. Daya Sagar**
+ Machine learning tools for mineral systems modelling and mineral predictive mapping **Geological Survey of Finland (GTK), Finland + Beak Consultants GmbH, Germany**
+ Fundamental Deep Learning Concepts for Applied Geoscientists **Xiao Xia Liang, Dany Lauzon, Tao Wen**
+ Practical use of multiple-point statistics algorithms - within Python - to generate heterogeneous 3D property fields **Guillaume Pirot**

Abstract submission closes March 16, 2026 **www.iamgconferences.org/iamg2025**

The 23rd Annual Conference of the International Association for Mathematical Geosciences (IAMG 2025)

The 23rd Annual Conference of the International Association for Mathematical Geosciences (IAMG 2025) was successfully held in Zhuhai, China, from October 9 to 14, 2025. The conference theme, Data-Driven Discovery in the Geosciences, highlighted the growing role of artificial intelligence (AI) in advancing the discipline. More than 300 scholars from 25 countries attended the conference, with a focus on AI, data science, and intelligent mineral prospectivity mapping (Fig. 1).

Fig. 1. Group photo of IAMG 2025 attendees

The opening ceremony was chaired by Prof. Qiuming Cheng (Fig. 2). Professor Tianxin Lin (Fig. 3), Vice President of the Sun Yat-sen University, welcomed delegates on behalf of the host institution, while Dr. R. Tolosana Delgado (Fig. 4), President of the IAMG, outlined the event's vision in his opening remarks.

Fig. 2. Conference Chair Prof. Qiuming Cheng hosting the opening ceremony

Fig. 3. Professor Tianxin Lin, Vice President of the Sun Yat-sen University, welcoming delegates

Fig. 4. Dr. R. Tolosana Delgado, IAMG President, delivering opening remarks

IAMG 2025 emphasized AI as foundational pillars of modern mathematical geosciences (Fig. 5). Three key domains emerged as critical frontiers:

(1) AI: Deep Learning architectures, including generative adversarial networks, graph neural networks, and transformers, are now widely applied for mineral identification, geochemical anomaly detection, seismic inversion, and 3D modeling. Diverse machine learning algorithms have been extensively used in mineral prospectivity mapping and geohazard prediction, enabling predictive analytics with unprecedented accuracy.

(2) Big Data & Large-Scale AI Models: The emergence of large language models, such as GeoGPT and Mini-CarbonGPT, demonstrated AI's capacity to streamline knowledge discovery and decision support. The integration of digital twin technology further showcased their potential for building high-fidelity virtual models of geological systems, bridging theoretical models with real-world applications.

(3) Geostatistics & Spatial Modeling: Advances in higher-order geostatistics, multipoint statistics, and compositional data analysis are empowering researchers to reinterpret complicated geochemical datasets. These advancements addressed long-standing challenges in spatial modeling, enhancing predictive accuracy for resource exploration and environmental monitoring.

IAMG 2025 featured 22 technical sessions, including 153 oral presentations and 44 posters, highlighting cutting-edge developments in AI-driven geosciences. This conference had two pre-conference short courses, led by Klaudia Oleschko (University of Mexico) and Shaun Lovejoy (McGill University), and seven keynotes, including Alik Ismail-Zadeh (Karlsruhe Institute of Technology), Anna Nguno (Geological Survey of Namibia), Renguang Zuo (China University of Geosciences, IAMG Distinguished Lecturer 2026), Guoxiong Chen (China University of Geosciences, Andrei Borisovich Vistelius Research Award 2025), Anirudh Prabhu (Carnegie Institution for Science, Andrei Borisovich Vistelius Research Award 2025), Dario Grana (University of Wyoming, Felix Chayes Prize 2025) and Dionysios Christopoulos (Technical University of Crete, Georges Matheron Lecturer 2024).

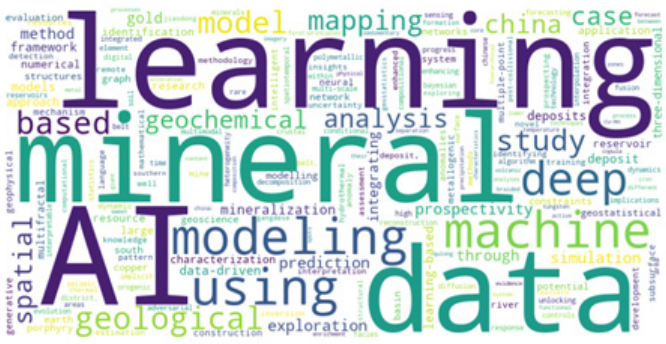


Fig. 5. Word cloud for conference presentations

IAMG 2025 demonstrated the growing role of mathematics and data science in decoding Earth's complexities. As AI continues to redefine methodologies in areas like mineral exploration and disaster risk assessment, the field is transitioning into an era of predictive, real-time analytics.

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南方海洋科学与工程广东省实验室（珠海）
Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai)


The 23rd Annual Conference of the International Association
for Mathematical Geosciences (IAMG 2025)


IAMG2025


通譽餐厅

Distinguished Lecturer Updates

Distinguished Lecturer 2026
Professor Renguang Zuo

Professor Renguang Zuo received his B.S. and Ph.D. degrees from the China University of Geosciences (CUG), Wuhan, China, in 2004 and 2009, respectively. He is currently a full professor at the State Key Laboratory of Geological Processes and Mineral Resources, CUG. In 2014, he was a senior visiting fellow at the James Cook University, Australia.

His research focuses on big data analytics and machine learning-based mineral prospectivity mapping and geochemical anomalies identification. Dr. Zuo has published over 160 peer-reviewed journal papers, 6 books, and book chapters. He has served as the Guest Editor for 8 special issues in international high-quality journals. His publications have amassed over 9,700 citations (Google scholar) across a range of esteemed international journals. In 2023, Dr. Zuo was awarded the Gold Medal, which is the highest award by the Association of Applied Geochemists (AAG). In addition, he was the inaugural recipient of the Kharaka Award by the International Association for GeoChemistry in 2015. Meanwhile, he was recognized as the Elsevier highly cited Chinese scholar and the World's Top 2% Scientist.

Dr. Zuo is the Vice President of AAG (2024-2025), and was a councillor of IAMG (2020-2024). He has received fellowships from AAG, Society of Economic Geologists, and Geological Society of London. He has been heavily involved in the editorial boards of many SCI-indexed journals, including Journal of Geochemical Exploration, Geochemistry: Exploration, Environment, Analysis, Computers & Geosciences, Natural Resources Research, Ore Geology Reviews, and Journal of Earth Science.

Lecture 1: Data-knowledge dual-driven mineral prospectivity mapping

Mineral prospectivity mapping (MPM), as a computer-based approach to delineate target areas for a specific type of mineral deposits. MPM typically comprises knowledge-driven and data-driven models. Knowledge-driven MPM relies on expert knowledge, which is based on causal relationships but is not readily adaptable to dynamic changes. Data-driven MPM is capable of identifying underlying data patterns but involves poorly interpretable decision logic. This lecture will focus on the state-of-art big data analytics and AI in MPM to devise a data-knowledge dual-driven model coupling AI with a mineral systems approach to MPM.

Lecture 2: Big data analytics and AI-driven geochemical mapping

Geochemical mapping plays a crucial role in mineral exploration and environmental monitoring by providing insights into geological events and processes such as mineralization and environmental pollution. With the advent of the big data era, how to apply big data analytics and AI to mine geochemical exploration or environmental data from a variety of geological and environmental settings to extract subtle and complex geochemical anomalies associated with mineralization or pollution has become even more challenging. This lecture will focus on the state-of-art big data analytics and AI in geochemical mapping and document successful case studies.

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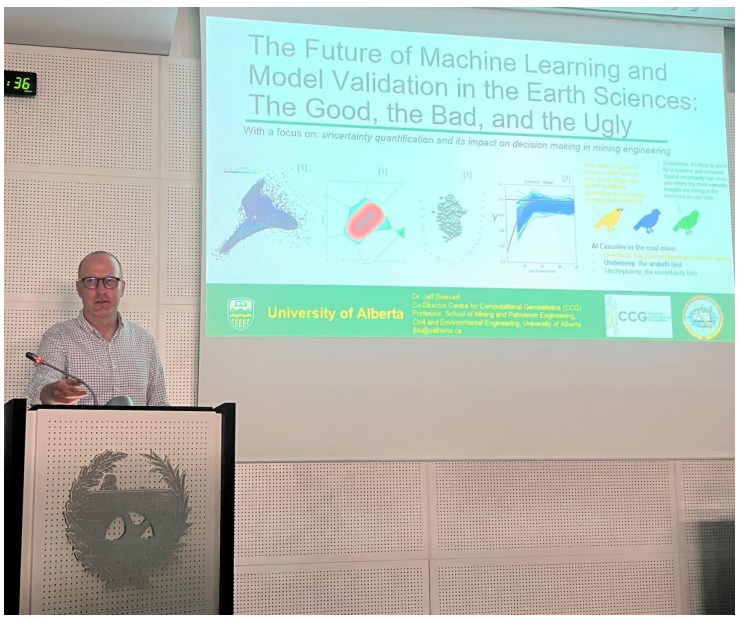
Distinguished Lecturer 2025
Jeff Boisvert

Dr. Jeff Boisvert is a professor in Civil and Environmental Engineering, School of Mining and Petroleum Engineering, at the University of Alberta and co-director of the Centre for Computational Geostatistics (CCG). His research focuses on spatial modeling and geostatistics in the fields of mining, energy, and wildfire. He uses spatial numerical models to improve decisions in mine design, resource/reserve estimation, wildland fire management/response, and well planning/placement/management. He has been presenting on:

- The future of machine learning and model validation in the earth sciences: The good, the bad, and the ugly

- Understanding, incorporating, and assessing the impact of uncertainty in our decisions: Why are we still so reluctant?



Member News

Vale Donald Myers

Donald E Myers, Emeritus Professor of Mathematics and Hydrology at the University of Arizona, passed away peacefully with the love of his wife Ruth, daughter Jill and the other family at the 7th of October 2025. He was 93 years old.

Don Myers' scholarship and service were formally recognized by the mathematical geosciences and spatial statistical community, including acknowledgments from the Journal of Mathematical Geosciences, Spatial Statistics and related professional outlets. He was nominated IAMG distinguished lecturer in 2008 and was considered a leading and inspiring scientist within the IAMG for his long-standing research activities, with theoretical and practical contributions in Geostatistics, Spatial Statistics, and Mathematical Geosciences. He published more than 200 papers in outstanding journals, several co-authored with prominent researchers all over the world, among whom his top co-author Donato Posa, demonstrating a wide net of scientific connection. His scientific activity spanned areas of theoretical mathematics, such as properties of complex analytic functions, topologies of Laplace transform, up to various fields in Geostatistics, where he particularly provided relevant contributions in multivariate geostatistics and spatio-temporal modelling. all familiar in the international scientific community. An important scientific contribution was the matrix formulation of co-kriging, providing a compact and general mathematical framework for multivariate spatial modeling and prediction. Key works refer to the consequences of spatial structure for ecological survey design and inferencial aspects in spatial ecology as well as to theoretical advances in geostatistical methods, related to stationarity of random fields, variogram estimation and modeling, in space and in space-time and their applications to soil science, plant pathology, environmental quality and hydrogeology. These contributions have produced highly cited publications that combine rigorous mathematical formulations with practical relevance for earth science challenges. They enable effective modeling, prediction, and survey design for spatial and spatio-temporal phenomena. Moreover, he has mentored numerous graduate students, representing a guide for young researchers and stimulated constructive discussions among collegues. He happily received visitors in his office at the University of Arizona for longer and shorter periods, dealing with their scientific questions.

Apart from his boundless knowledge and compentence, he was curious, had a positive critical approach, and a special love for life with a broad-spectrum interests from classical music (organ) to trips around the world, from sailing to singing in a choir. In all, we have lost a very special person of our community.

Sandra De Iaco, Donato Posa, Alfred Stein

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Marshall Ma's work recognized by GSA, GSIS, ESIP and AGU

Dr. Marshall Ma of the University of Idaho has recently received several honors recognizing his contributions to geoinformatics, data science, and community service. In 2025, he was awarded the Charles S. Falkenberg Award from the American Geophysical Union (AGU) and a Certificate of Appreciation from the Earth Science Information Partners (ESIP). His 2024 recognitions include the Annual Best Paper Award from the Geoscience Information Society (GSIS) and the M. Lee Allison Award from the Geological Society of America (GSA).

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IAMG Journal Reports

Journal Statistics

Mathematical Geosciences:

- 2024 Impact factor: 3.6
- 5-Year Impact Factor: 3.0
- Average review time: 12 days (submission to first decision (median))

Computers & Geosciences:

- 2024 Impact Factor: 4.4
- 5-Year Impact Factor: 5
- Average review time: 13 days (submission to first decision (median))

Natural Resources Research:

- 2023 ISI Impact Factor: 5
- 5-Year Impact Factor: 4.9
- Average review time: 6 days (submission to first decision (median))

Applied Computing and Geosciences:

- 2023 ISI Impact Factor: 3.2
- 5-Year Impact Factor: 3.6
- Average review time: 3 days (submission to first decision (median))

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2024 Student Research Award Reports

Mathematical Geosciences

MG-2024-1: Probing how the stochastic evolution of geosphere and biosphere influences Earth's sustainability and habitability:A machine-learning approach

Haitao Shang

Abstract: Earth's long-term habitability is governed by the coupled evolution of geosphere and bio-sphere over geological timescales. Both internal and external stochastic processes—such as episodic volcanism, tectonic reorganizations, asteroid impacts, and random innovations in microbial metabolisms—introduce variability in elemental cycles, atmospheric composition, and ocean chemistry. Here, we develop a machine-learning–enabled framework to quantify the influence of randomness in geological and microbial processes on Earth's environmental trajectory over millions to billions of years. Our models integrate the carbon, oxygen, sulfur, nitrogen, and phosphorus cycles across the lithosphere, hydrosphere, atmosphere, and bio-sphere, incorporating stochastic microbial evolution, probabilistic geophysical perturbations, and nonlinear feedbacks. Simulations reveal that atmospheric and seawater chemistry exhibit quasi-stable states punctuated by fluctuations in greenhouse gases, redox-sensitive species, and nutrient availability. Microbial metabolic variability, coupled with episodic geological events,generates emergent, probabilistic trajectories that shape organic carbon preservation, nutrient cycling, and climate stability. These results highlight that Earth's long-term habitability is not a deterministic outcome but emerges from a complex interplay of stochastic geobiological processes, emphasizing the importance of probabilistic approaches for understanding planetary resilience and the evolution of life-supporting environments.

MG-2024-2: GenAI Minimum Acceptance Checks: Static and Dynamic Model-Checking of Conditioning Generative Artificial Intelligence Models for Subsurface Modeling

Ahmed Merzoug, The University of Texas at Austin, USA

Abstract: To improve decision-making in subsurface development, we need accurate ensembles of geological models that incorporate all available data. While generative AI (genAI) offers a powerful alternative to traditional geostatistics by integrating qualitative geological concepts, its validation is often limited to visual checks and basic statistics. This creates a risk of using misleading models that lead to poor outcomes. To solve this, we propose an expanded model-checking protocol with new metrics and diagnostics. Our protocol rigorously assesses key attributes such as statistical distributions, uncertainty, spatial continuity, data conditioning, and dynamic behavior. We tested this protocol by training a variational autoencoder (VAE), generative adversarial networks (GAN), and diffusion denoising probabilistic models (DDPM) on synthetic geological data. The results demonstrated that GANs successfully passed all evaluations, DDPMs showed weaknesses in modeling local uncertainty, and VAEs failed most checks. This enhanced workflow provides a quantitative method for evaluating and selecting the most reliable genAI model, ultimately boosting confidence in development decisions based on the resulting subsurface realizations.

MG-2024-3: Data-driven mineral big data mining in support of mineral exploration

Bin Wang, China University of Geosciences, China

Abstract: Identifying mineral assemblages is crucial for developing a better understanding of ore genesis and improving mineral exploration efficiency. Traditional geological methods have provided significant insights into the classification of the many different gold deposit types and their genesis, but they typically occur at the deposit to thin section scale and focus on small, local datasets. This study developed a data-driven approach, leveraging machine learning and big data to determine the characteristic mineral assemblages of six globally significant gold deposit types: orogenic, epithermal, porphyry, Carlin, iron oxide-copper-gold (IOCG), and volcanogenic massive sulfide (VMS). We utilized a machine learning approach—association rule mining (ARM) with an improved Apriori algorithm, which constrains rules consequent to deposit types, to a global database of 454 gold deposits, aiming to unravel the characteristic mineral assemblages of six of the world's most economically significant gold deposit types. Visualization of the rule set through bipartite and unipartite networks revealed distinct mineral-to-gold deposit relationships. This study also showed that a machine learning approach to big data analytics of a global mineralogical database can detect both known and as of yet unrecognized mineral associations. As such, our approach, which links geology and big data, offers new opportunities for mineral exploration targeting and gold deposit research.

Computers & Geosciences

CG-2024-2: Domain adversarial neural network driven by synthetic datasets for mapping mineral prospectivity

Lin Qiuyi

Deep learning have been employed for mineral prospectivity mapping (MPM) for automatic extraction. However, extending the application of deep neural networks to areas with different ore-forming characteristics remains a challenge because it requires integrating the geological knowledge learned in one area with that of other areas. Unsupervised domain adaptation is a major strategy in transfer learning that can address the problem of poor network generalization. In this study, an improved unsupervised domain adversarial adaptation network driven by synthetic data was constructed for MPM. Ample synthetic datasets were used to build the training set. An improved loss function embedding the maximum mean discrepancy was designed to achieve interdomain feature alignment in an unsupervised scenario. Northwestern Hubei, China, was chosen as the source area, and southeastern Hubei as the target area for polymetallic mineralization of gold (Au). Experimental results showed the constructed neural network exhibited better performance and domain adaptation capability in the target domain than the baseline methods. The delineated high-potential zones showed strong spatial correlations with known Au poly-metallic mineralization in the target area.

CG-2024-5: D4Xgui – a processing tool for baseline correction and standardization of carbonate clumpedisotope raw data

Miguel Bernecker, Johann Wolfgang Goethe-Universität Frankfurt am Main, Germany

Abstract: D4Xgui is a browser-based, open-source tool for baseline correction and standardization of carbonate clumped isotope raw data. Clumped isotope geochemistry investigates small statistical anomalies in the abundance of multiply-substituted isotopologues, which are temperature-dependent. Determination of ppm-ppb quantities of mass 47-49 isotopologues of CO2 is commonly achieved through gas-source isotope-ratio mass spectrometers, with resulting metrics being defined as $\Delta 47$ -$\Delta 49$ values. The clumped isotope community demonstrated that $\Delta 47$ data between 22 laboratories becomes indistinguishable when raw data are processed using state of-the-art standardization schemes and full error-propagation with the D47crunch library (Daëron, 2021). D4Xgui introduces a dedicated pressure baseline (PBL) correction step, essential for minimizing analytical bias induced by secondary electrons. The tool features a user-friendly graphical interface, supports full error propagation, and offers extensive graphical outputs for data visualization and quality control. Resulting metrics from correction and standardization, alongside their corresponding statistics, can be explored on interactive plots and spreadsheets, all of which are downloadable. A self-contained database ensures FAIR data handling by storing mass spectrometric raw data for future use. D4Xgui democratizes access to advanced

data processing workflows, enabling rapid, reproducible, and transparent analysis of carbonate clumped isotope data without requiring programming expertise. Its modular architecture and planned data integrations ensure adaptability to evolving research needs, promoting FAIR data principles and long-term reusability.

Natural Resource Research

NRR-2024-5: Understanding material cycles along convergent plate boundaries by linking geochemical data to plate models

Yuepeng Zhang, State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan, China

Abstract: Convergent plate boundaries are critical regions for material cycling and energy transfer within the Earth, playing a key role in understanding deep-time Earth system evolution. This study aims to systematically analyze the processes of material cycling and evolution at plate boundaries by constructing a global deep-time geoscience dataset and integrating subduction dynamic parameters and magmatic geochemical characteristics reconstructed by GPlates. Big data analytics and artificial intelligence techniques are applied to integrate spatiotemporal data from different tectonic domains, magmatic geochemical response units, and key subduction parameters, revealing the coupling patterns between subduction zone dynamics and geochemical features. The results demonstrate that the dynamic evolution of subducting plates significantly influences material cycling pathways and the spatiotemporal distribution of geochemical characteristics, while also highlighting distinct evolutionary behaviors among different geochemical response units. This research provides a systematic framework for understanding deep-time material cycling mechanisms and evolutionary trends within the Earth system and offers a methodological and data-driven foundation for future interdisciplinary studies on the coupling between geodynamics and geochemistry.

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2025 Recipients of Student Research Grant Awards

Computers and Geosciences Research Scholarship

CG-2025-10: He Zongcong - First-principles and molecular dynamics simulations of In and Sn substitution for Zn in sphalerite: Implications for critical metal mineralization

CG-2025-12: Faber Marthe - Deciphering Local Controls on σ13C Excursions in the Nama Group: Insights from a Geological Process Model

CG-2025-6: Twickler Silas - Classification and Analysis of Supraglacial Water From Melting and Surging Through a Data-Fusion Approach to Machine Learning

CG-2025-11: Hernandez Patricio - Modelling hydrogeological systems in fractured media using hybrid deep learning approaches: a demonstration with real data

Mathematical Geosciences Student Award

MG-2025-5: Zhang Yuesen - GeoYOLO-GCN: A Multi-Scale Graph Convolutional Network Framework for Geochemical Anomaly Detection

MG-2025-9: Magnabosco de Almeida Gomes Rafael - Development of a Novel Loosely Coupled Model for Integrated SW-GW Simulation

MG-2025-4: Nasretdinova Milena - Sensed core data to predict process responses for mining projects

Natural Resources Research Student Award

NRR-2025-3: Weilin Chen - Neuro-Symbolic AI for Geochemical Prediction in Ore Deposit Systems

NRR-2025-1: Luyi Shi - Foundation Model for Geochemical Anomaly Identification

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2025 Recipients of Student Travel Awards

International Association for Mathematical Geosciences
(IAMG)

c/o IAMG Office
Balthasar-Rößler-Str. 58
09599 Freiberg
Germany