Critical Metals and their Deposits: State-of-the-art knowledge, Future Directions of Research and Exploration Insights

A three days' Workshop

Under the aegis of

Government of India, Department of Education

Scheme for Promotion of Academic Research Collaboration (SPARC)

Organized by

Department of Geology & Geophysics, Indian Institute of Technology, Kharagpur WB India
In collaborationwith
Research School of Earth Sciences, Australian National University, Canberra ACT, Australia

December 8 to 10, 2025

Venue: Gargi Auditorium, Ramanujan Complex, IIT Kharagpur

First Circular

Background: The workshop is a part of an international collaborative project under the Scheme for Promotion of Academic and Research Collaboration (SPARC) between the Department of Geology & Geophysics, IIT Kharagpur and Research School of Earth Sciences, Australian National University, Canberra. The SPARC project provides an appropriate platform for sharing knowledge and collaborative research. The current project was formulated to work on some key aspects of hydrothermal systems associated with felsic magmatism in India. Most critical metals (Cu, Mo, Sn, W, Nb, Ta and REEs) are associated with felsic magmatism (granitoids, alkaline and carbonatite complexes) and are the most sought after in the present scenario. Over the past five decades, there have been significant developments in the understanding of the genesis of deposits of these metals through field studies, laboratory investigations, experiments and theoretical modelling. The workshop is meant to take stock of the state-of-the-art knowledge, bring the existing gaps home to young participants and discuss possible future directions that will help understand these deposits better for gaining deeper insights to the exploration of these metals. The theme of the workshop is quite apt to the present scenario of increasing demand for the critical metals for hi-tech industries and the increased governmental initiatives to augment the resources of these metals. The workshop will have three components of knowledge sharing, hands-on training and discussions. Aspects of ore genesis synthesized from field, experiments, and theory will be the focus with emphasis on modern theoretical approaches of understanding metal partitioning in solid-melt-fluid systems, transport of these metals (including REEs) in aqueous medium predicted from atomistic simulations. Ore genetic models provide insights to explotration by identifying parameters for knowledge-driven prospectivity modelling. A large component of exploration is also based on empirical data-driven models and is widely adopted today. The workshop is designed to expose participants to modern approaches of prospectivity modelling for exploration of critical metal deposits, using knowledge- data-driven methodology using AI tools. The participants will get the opportunity of sharing knowledge with internationally acclaimed experts.

Convenors:

Prof. John A. Mavrogenes, of the Research School of Earth Sciences, Australian National University, Canberra, is a widely acclaimed expert in the field of Experimental Ore Geology. He has contributed extensively to metallogeny of copper (porphyry copper deposits), gold and REE deposits, integrating field and experiments. He is an international authority in the field, teaching and researching on ore deposits since 1994 at RSES, ANU, Canberra. Prof. Mavrogenes has in the past worked and currently working on REE deposits across continents.

M. K. Panigrahi, of the Department of Geology and Geophysics, IIT Kharagpur is an Ore Geologist who has contributed significantly to the understanding of copper (Malanjkhand), gold (Dharwar) and rare metal deposits (Bastar) in India. He uses quantitative techniques to understand the magmatic-hydrothermal systems and is an expert on Fluid Inclusions and many other analytical techniques. He also contributes to computerized mineral exploration. He has been teaching Economic Geology, Mineral Exploration and Computer modelling since 1995 at IIT Kharagpur.

Invited Speakers and Resource Persons

Prof. Alok Porwal, Professor at the Centre of Studies in Resource Engineering is an authority in Mineral Exploration, especially various types of data and knowledge-driven techniques of mineral prospectivity modelling using state-of-the-art soft computing techniques using Machine Learning. He has been contributing extensively to exploration of Li, Cu, REEs and rare metals across continents for more than last two decades.

In addition, we are going to have resource persons who are experts on theoretical modelling of metal partitioning in magmatic systems and transport of metals in hydrothermal fluids with special reference to critical metals (including REEs). We shall update them shortly after finalizing the schedule which will be available on this site. We shall have online lectures and interactions with some of the resource persons who will not be able to travel to Kharagpur.

Workshop Outline

The tentative plans of the workshop are as follows:

- Young researchers from academia (Research Scholars and young faculty engaged in teaching Ore Geology) and Industry (Scientists from GSI, AMD and other organizations engaged in exploration of critical metals) are encouraged to participate in the workshop.
- Sessions would involve lectures covering key aspects of genesis of critical metal deposits using data from field, experiments and various advanced analytical methods. Hands on practical training for quantitative understanding of magmatic-hydrothermal systems using computer programs and available software will be imparted. Sessions will be devoted to get participants acquainted with modern methodologies of mineral potential mapping / prospectivity modelling for critical metal deposits with particular reference to India.
- We plan to invite other resource persons from within India who are active researchers in the area to share their knowledge and experience with participants on this important topic.
- Some sessions will be reserved for **oral presentation** of selected participants who are actively researching on the problem and/or engaged in exploration to present their work as case studies. There will be **poster sessions** for participants who will not get a chance to present orally. Best oral presentation and best poster will be recognized with certificates.
- All materials will be available to participants in form of videos and soft copy to be kept on Google drive with access to all participants for downloading. No workshop proceedings in form of hard copy will be available.

Participation Details: We can accommodate a maximum of **75** participants in this workshop under constraints of funds and logistic support. Participation will be allowed on a first-come first-served basis. Registration is free for all. Graduate student participants from Institutes/Universities will be provided free accommodation in Students' Halls of Residence in IIT Kharagpur campus on twin sharing basis. Participants from Industry and Government Organizations (young faculty from Universities / Institutes, Geologists/Scientists from government agencies involved in study of ore deposits and exploration) will be provided accommodation on a chargeable basis (@Rs500 per day in one of the Halls of Residence). No TA will be reimbursed to participants. All queries related to the workshop may please be mailed to the convenor (mkp@gg.iitkgp.ac.in).

A Google form is being circulated to which participants may please respond in the given link (https://docs.google.com/forms/d/e/1FAIpQLSekNVBQDYt7YDWjkgWxsg7FfwGZKoh-r4Mow7ubmXM_vmYvIw/viewform?usp=header) .