INDIA-AUSTRALIA JOINT WORKSHOP ON CRITICAL MINERALS RESEARCH FOR SUSTAINABLE TRANSITION TO GREEN ENERGY

AICMRH

Organized by
Department of Earth Sciences
IIT Bombay
(3-4 March 2023)

IIT Bombay

Monash University

Conveners

Prof. Sakthi Saravanan Chinnasamy
Department of Earth Sciences

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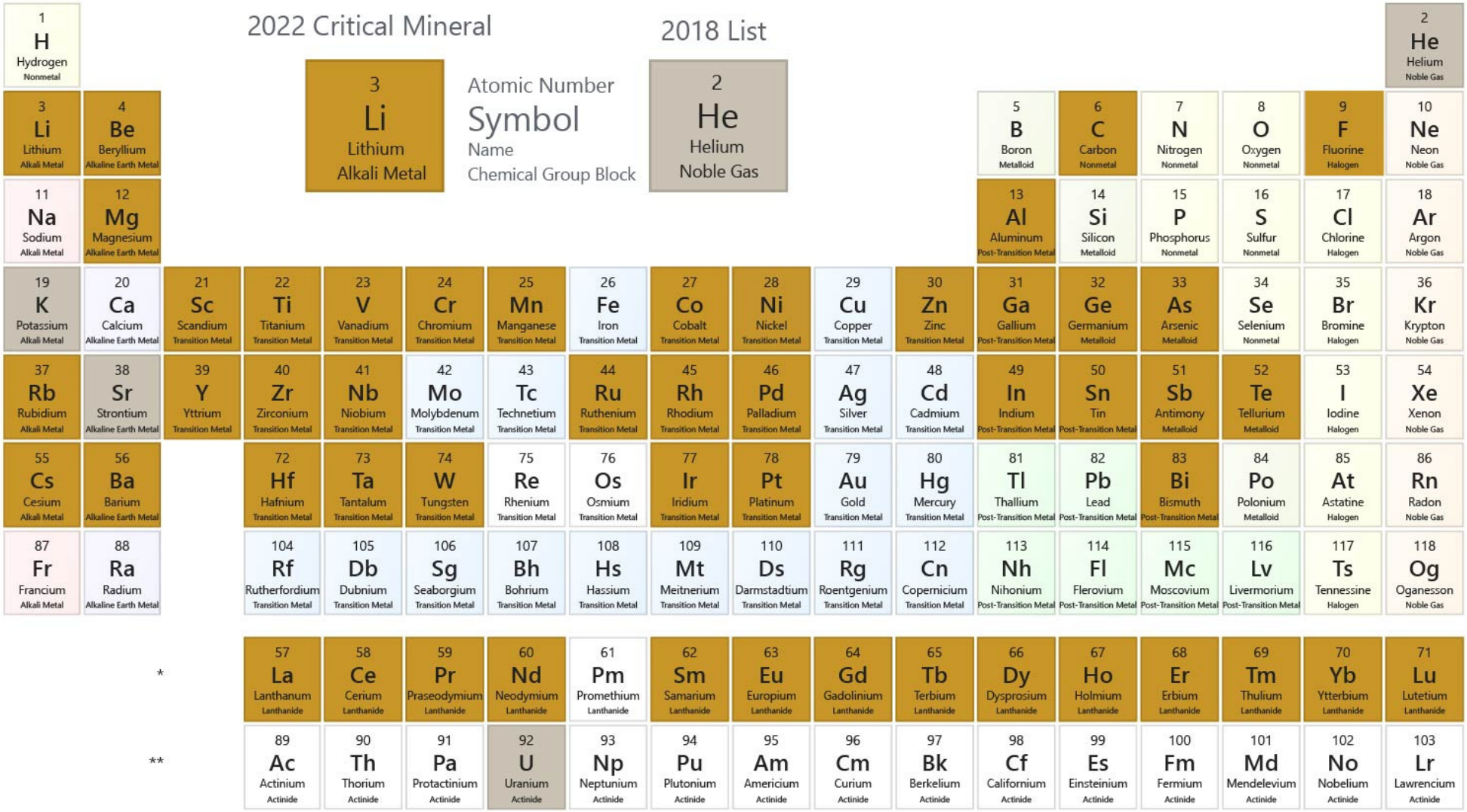
Periodic table of elements highlighting the “critical minerals”



INDIA-AUSTRALIA TWO-DAY JOINT WORKSHOP WORKSHOP ON CRITICAL MINERALS RESEARCH FOR SUSTAINABLE TRANSITION TO GREEN ENERGY

DEPARTMENT OF EARTH SCIENCES, IIT BOMBAY, INDIA

Critical Minerals and India:

India has an ambitious industrial reform agenda to expand manufacturing capacity and transition to a low-carbon and digital economy. The Indian government has set ambitious targets for several sectors; for example, it has set a very ambitious renewable energy generation target of 175GW by 2022 and 450GW renewable energy by 2030. Moreover, it aims to have 30 percent of vehicles powered by electricity by 2030, which requires critical minerals. It is crucial for India to maintain a constant supply chain of critical minerals in order to make many government programs, such as Atmanirbhar Bharat and Make in India, a success.

Critical metals (CM) are vital for renewable energy applications and their supply remains uncertain. "Critical metals" for renewable power generation include metals such as lithium, used in batteries, and rare earth elements, used in magnets for wind turbines and electric cars. To secure the supply of critical minerals as demand surges due to the growing manufacturing sector under the ambitious 'Make in India' initiative of the Prime Minister of India, robust and resilient supply chains and new and cost-effective tools and flowsheets for recycling extraction and recovery processes will be required.

Raw materials (minerals) are the fundamental determinants of the growth of the manufacturing industry; their availability, quality, and supply adequacy - in both the short term and long term - have been perennial international concerns over at least the last century. Securing reliable, sustainable, and undistorted access to certain raw materials will be one of the precursors to realizing the dream of making India the world's manufacturing hub in the 21st century as well as transforming India through the creation of one hundred smart cities, ambitious industrial reforms agenda to expand manufacturing capacity and to transition to a low-carbon and digital economy as envisaged by the Prime Minister of India. A stronger manufacturing industry also calls for a continuous and uninterrupted supply of raw materials (minerals), sound fiscal policy, and resilient and robust infrastructure. Whilst the government is striving hard to establish the latter two, there seems not enough attention is being paid to the issue of ensuring a 'continuous and uninterrupted supply of critical raw materials'.

Critical minerals and collaboration opportunities for India:

In 2020, India-Australia Leaders' Virtual Summit held on 04 June 2020, the Hon'ble Prime Minister of India, Shri Narendra Modi, and the Hon Scott Morrison, Prime Minister of Australia, jointly participated and committed to elevating the bilateral Strategic Partnership concluded in 2009 to a Comprehensive Strategic Partnership (CSP). The two areas that stood out in the CSP that are of particular significance to 'Indo' are the MOUs on 'Education, Research and Skills' and on '*Cooperation in the field of Mining and Processing of Critical and Strategic Minerals*' as part of the Enhancing Science, Technology and Research Collaboration agenda.

Accordingly, Australia wants to support India in developing a domestic critical minerals processing industry. This would provide Western nations with an alternative to sourcing materials from China. They further observed that "we will work together to support the development of education campuses in each other's countries." A Memorandum of Understanding on cooperation in the field of mining and processing of critical and strategic minerals was signed. Both the leaders met again in on 29th September 2021 again in Washington and New York as part of the Quad dialogue, and critical minerals were part of the discussions.

Critical Minerals Research – the Indian Context

At present, in India, there is no dedicated research group conducting research into critical minerals. Taking a cue from the recent geopolitical developments and partnership agreements between India and Australia, IIT (BHU) Varanasi is spearheading the establishment of '***The Indo-Australian Critical Minerals Research Collaboration Hub'***. The proposed hub will initially bring together leading academicians, researchers, and industry leaders from both sides. They will work on several issues related to the development of methodology for the exploration and extraction of critical minerals. Jointly led by IIT Bombay and Monash University, Australia, the hub will oversee collaboration with researchers from several other Indian (IITB, IITKGP, IITR, IITM, IITK, IITG, IIT Dhanbad, NITR, NITK, IIITH, Nalanda University, and other national research laboratories) and Australian universities and research organizations (RMIT University, University of Melbourne, CSIRO, Deakin University, University of Queensland, UNSW, Latrobe University, and Federation University) industry partner organizations and leading international researchers. In due course, the Hub will be expanded to the Indo-Pacific region by including researchers from other countries in the region.

Over the next 5-7 years, the Hub will develop technologies for a competitive and environmentally sustainable future for Indian mineral industries. This will be done through high resource recovery, and reductions in energy and water use. This Hub will provide advice, ideas, and expertise to assist policymakers and help secure the vital supplies of resources needed to drive the new energy economy. It will also support the future workforce in the resources sector.

The First of the Series of Workshops:

The Department of Earth Sciences at IIT Bombay organized a joint workshop on "Critical Minerals Research for Sustainable Transition to Green Energy" under the Institute of Eminence (IoE) grant during 3-4, March, 2023 at VMCC, IIT Bombay in association with Monash University. It is part of a joint research initiative between Indian and Australian universities called the "Australia India Critical Mineral Research Hub (AICMRH)" to address the critical need for sustainable supply chains of critical minerals for green energy. The occasion was graced by the presence of two distinguished guests, Dr. Deependra Singh, CMD, IREL (India) Ltd., and Mr Sanjiva De Silva, DFAT, Government of Australia. During the workshop, five themes were discussed, including Geology and Resources, Mineral Exploration and Targeting, Mineral

Processing and Recovery, Mine Waste Utilization and Recycling, and Policy and Governance. Participants in the two-day seminar included eminent scientists, company executives and government officials from India and Australia. In attendance, were over 100 people from industry, government and research with an interest in the development of our Critical Minerals industry. The keynote addresses and scientific presentations were followed by comprehensive brainstorming sessions to discuss issues related to critical mineral research and its sustainable supply chains in India. A report on the outcome of the workshop will be submitted to the Ministry of Education, the Ministry of Mines, the Ministry of External Affairs, and the Ministry of Non-Renewable Energy to attract funds for critical mineral research.

The broad focus of the workshop was to:

- ·Present understanding of domestic critical minerals resources
- ·Mineral exploration and source diversification
- ·Recovery of critical metals from solid and liquid wastes
- ·Mineral processing and recycling Technologies
- ·Critical mineral policies and regulations
- ·Impact of critical mineral production on health and environment

During the workshop, the deliberations focused on the following objectives:

- ·To work through the opportunities and challenges involved in building sustainable supply chain(s) for critical minerals from both countries.
- ·Identify research themes associated with critical minerals supply through short-, mid-, and long-term action plans in project mode.
- ·To identify emerging issues in critical minerals, supply chains, and the nation's current vulnerabilities to potential disruptions.
- ·Strengthen India's critical minerals supply chains.

Key recommendations from the workshop:

A common theme that emerged in the workshop is the need for international collaboration between governments, industry, and academia. If governments, academia, and industry are interested in participating in any given critical mineral study, it is essential that they share an understanding with respect to the details and complexities of criticality, and the root causes of criticality. Specific recommendations of the workshop include the following:

- Establishing and sustaining a "***National Critical Minerals Taskforce***" under the Chairmanship of the **Hon'ble Minister of Mines** with membership from the Ministry of Mines, Ministry of New and Renewable Energy and Ministry of Defence with engagement from key stakeholders across industry, academia, and relevant government agencies.
- A dedicated "***Centre(s) of Excellence***" should be created with a bridging team between academia and industry underpinned by funds to support state-of-the-art research infrastructures that can address the key issue of the current and future talent pipeline.
- Encouragement of fundamental research on developing empirical genetic models and understanding the processes of enrichment of critical minerals in the Earth's crust. Industry, government, and academia should work together strategically at an early stage.
- We need sustained funding for research to tackle and solve these multidimensional problems (geology, processing, economics, environmental, social and governance (ESG), mar (SERB)ket dynamics, resource competition, regulatory frameworks, etc.), and to be able to train the workforce of the future. In short, make use of the talent and willingness of universities. A separate fund granting board, similar to Science and Engineering Research Board, should be created and all the R&D projects can be managed through it.
- Indian government should do more to significantly improve cross-border cooperation, especially between Indian-Australian governments, research institutions, and industry by supporting the establishment of the Critical Minerals International Alliance.
- Generate an integrated data set comprising geology, remote sensing geochemistry, and geophysics. Creating open source and managing the large data set, including the rate of failures and successes.
- Adapting state-of-the-art Artificial Intelligence (AI) and Machine Learning (ML) tools at various scales to efficiently evaluate.
- Find out the gaps and technology setbacks in the mineral extraction processes.
- Look for alternative secondary sources of critical minerals than the primary ores, such as ore tailings, fly ash dams, smelter waste streams and discarded electronic wastes.
- The upstream side of Australia may support India's strong downstream. Proper SWOT analysis is explicitly required for critical minerals and scenario modeling to understand implementation in the Indian context.

- Several critical minerals supply chain-related workshops focusing on exploration and technology, markets and investments, and government policy and regulations should be organized to develop a community of practice that can continue to assist the national missions. This is somewhat similar to how China has developed high levels of industrial and scientific capability through the Chinese Society of Rare Earths (CSRE) founded in 1980.Mainly legislation, protocols, norms, standards, and policies need to be amended to facilitate the domestic industries to work in a mission mode (relaxation in auctioning, etc).
- Incentives in the form of monetary, recognition, or award to be provided for exploration, extraction, and production of critical minerals.

Consistent support for resource discovery

Resource discovery/exploration is often ignored; it is assumed we have plenty of resources in the ground and we know where they are, we just need to know how to process the ores and then add value. But this is not true for many metals. The pipeline of deposits that can feasibly be exploited in the future is relatively small, considering that ESG, infrastructure, water, and other factors will mean many deposits will never be mined. We need to focus on discovering new resources (some of which will be in tailings and mine wastes) are recognized, and that these are resources that can be feasibly mined (near enough to infrastructure corridors with energy and water available for example).

Geoscience Australia has done some commendable work in this area, and support for their work in critical minerals should be expanded and sustained for the long term.

R&D Partnerships

R&D partnerships should operate with the following three core principles, namely:

- ***Complementarity***

Establish complementary partnerships and build a mechanism that values and acknowledges the importance of strong relationships within and outside the country.

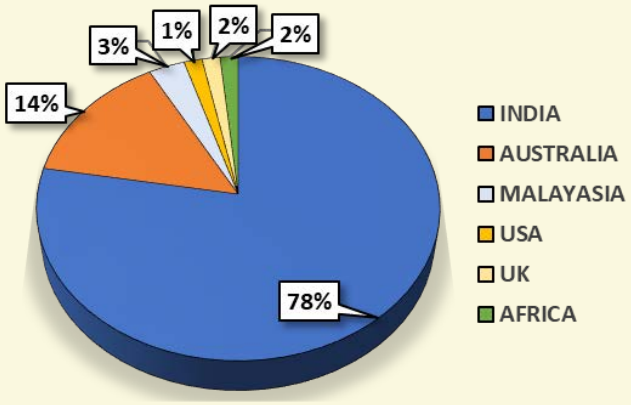
- ***Collaboration***

Promote exchanges and collaborations between academics and researchers in fields of minerals criticality assessments, critical minerals extraction, processing and separation and any other research priorities identified. Establish and sustain more bilateral (or multilateral) funding schemes that will enable outcome-driven research and education around critical minerals through competitive PhD and post-doctoral scholarships for researchers from partner countries. This will advance science diplomacy whilst reinforcing the ongoing trade diplomacy.

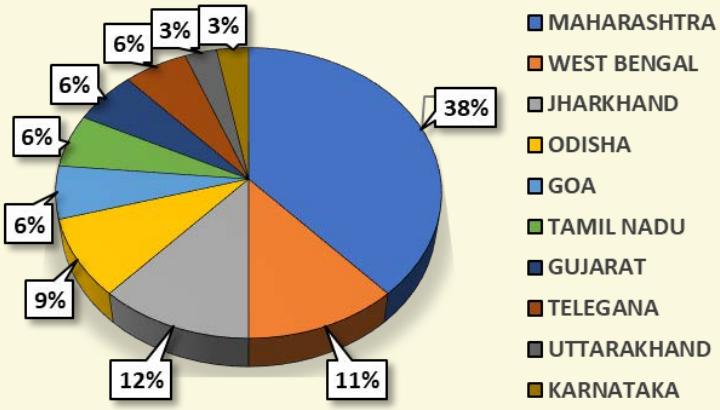
- ***Value***

Set up achievable targets and make sure we deliver tangible improvements in a timely manner, not measured only by the output of journal publications or reports but also through impact on policy and industrial practice, including number of patents filed.

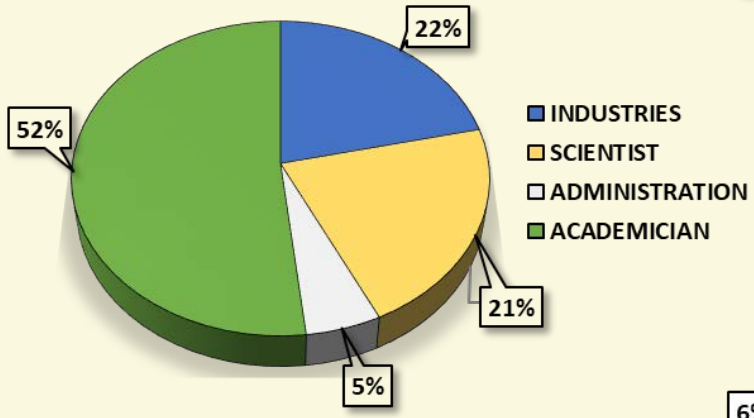
Participants across the World



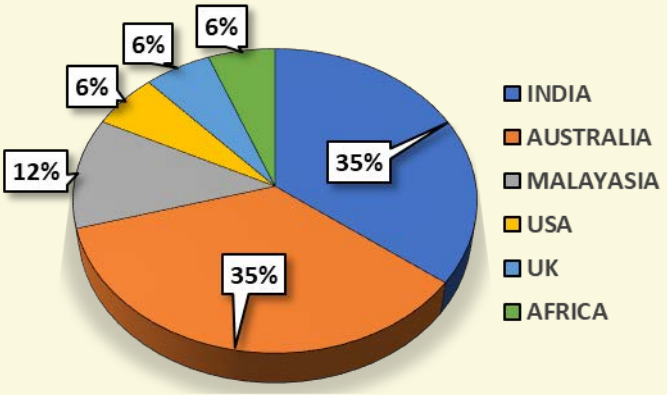
Statewise Participants within India



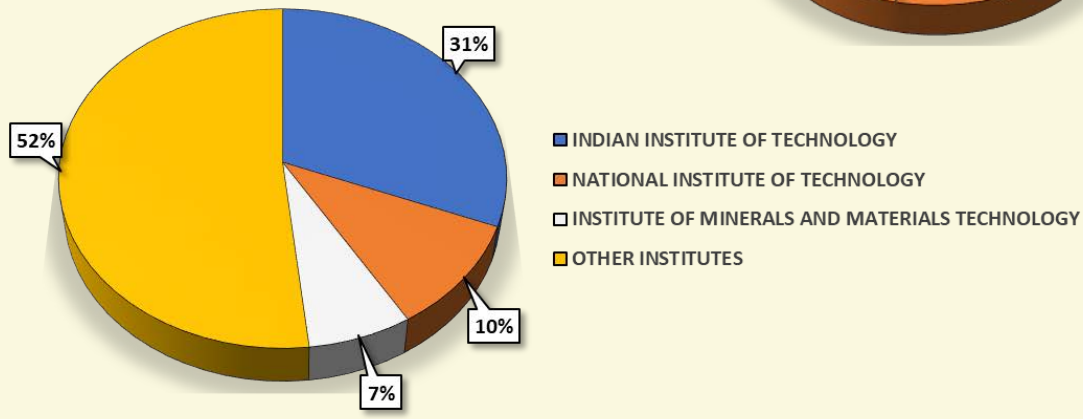
Participants from the different Expertise



Participants from different Institutes across the World



Participants from the Institutes within India

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3-4 March 2023
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
ज्ञानम् परमम् ध्येयम्
Australia India Critical Minerals Research Hub
Partnering for a new future

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