



PROGRAMME &
ABSTRACT BOOK



**SECOND
RUSSIAN-MALAYSIAN
SEMINAR ON CRITICAL
MINERALS
22-23 SEPTEMBER 2025**



**UNIVERSITI
MALAYA**



The First Higher Technical University in Russia
**EMPRESS CATHERINE II
SAINT PETERSBURG
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PREFACE

It is with great pleasure that I welcome you to the Second Russian-Malaysian Seminar on Critical Minerals, jointly organized by Universiti Malaya, Malaysia and the Empress Catherine II Saint Petersburg Mining University, Russia.

This seminar represents a continuing and deepening collaboration between our two institutions, built on a shared vision to advance research, innovation, and international dialogue in the field of strategic minerals.

These minerals, ranging from rare earth elements to platinum group metals and nickel, are indispensable to the energy transition, digital technologies, and sustainable development that define the global agenda today.

The program brings together a distinguished group of scholars, researchers, and industry experts from both Russia and Malaysia. Topics include cutting-edge developments in geochemistry, mineral processing, and metallurgy, as well as the economic, environmental, and geopolitical dimensions of mineral resource utilization. Such a comprehensive gathering of expertise highlights the importance of bilateral collaboration in tackling the pressing challenges of sustainability, resource scarcity, and technological advancement. I hope that this seminar serves not only as a platform for academic exchange but also as a strategic bridge, fostering long-term partnerships between institutions, researchers, and industries from both countries.

I would like to extend our deepest appreciation to our partners at Empress Catherine II Saint Petersburg Mining University, our keynote speakers, presenters, technical committee members, and all participants for their invaluable contributions to the success of this event.

We look forward to the fruitful discussions and collaborations that this seminar will undoubtedly inspire.



Prof. Ir. Dr. Nik Nazri Nik Ghazali
Dean
Faculty of Engineering, Universiti Malaya

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1. Seminar Organising Committee
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Programme Schedule

Day 1 : Monday, 22 September 2025	
14:00 – 14:15	Opening ceremony and welcoming speech Professor Ir. Dr. Nik Nazri Nik Ghazali, Dean, Faculty of Engineering, Universiti Malaya
Session 1: Dr Nursyahirah Mohd Shatar	
14:20 – 14:45	Professor Talovina Irina Vladimirovna Department of Historical and Dynamic Geology, Empress Catherine II Saint Petersburg Mining University Topic: Strategic Mineral Raw Materials of the Russian Federation: Platinum Group Elements and Nickel
14:45 – 15:10	Professor Dr. Hendrik Simon Cornelis Metselaar Department of Mechanical Engineering, Universiti Malaya Topic: Rare Earth Elements in Malaysia, Upstream And Downstream
15:15 – 15:40	Professor Skublov Sergey Gennadievich, Associate Professor, Petrov Dmitry Anatolyevich Department of Mineralogy, Crystallography, and Petrology, Empress Catherine II Saint Petersburg Mining University Topic: Geochemistry and Ore Potential of Rare Earth Elements in Russia
Session 2: Dr Chanthiriga Ramasindarum	
15:45 – 16:10	Associate Professor Ir. Dr. Syed Fuad bin Saiyid Hashim The Institute of Mineral Engineering (IME) Malaysia, Universiti Sains Malaysia. Topic: Empowering AI Tools In Training For Human Capital Development In Mining And Quarrying Industries
16:15 – 16:40	Professor Alexandrova Tatiana Nikolaevna Assistant Professor, Kuznetsov Valentin Vadimovich Department of Mineral Processing, Empress Catherine II Saint Petersburg Mining University Topic: Flotation theory and practice development in Russian Federation: state of the art
16:40 – 17:05	Dr. Mohd Zamri bin Zainon @ Baharom Department of Mechanical Engineering, Universiti Malaya Topic: Potentially of Rare Earth Elements (REEs) Business Investment in The State of Kedah, Malaysia
17:05	End of Day 1

Day 2 : Tuesday, 23 September 2025**Session 1: Dr Cheah Mei Yee**

14:00 – 14:25	Dr. Zulhelmi bin Amir Department of Chemical Engineering, Universiti Malaya Topic: Locking carbon in stone: Enhancing CO2 storage with natural surfactants
14:25 – 14:50	Associate Professor Isheisky Valentin Alexandrovich Department of Blasting Engineering, Empress Catherine II Saint Petersburg Mining University Topic: An Approach to Interpreting Geological Information from Blasthole Drilling Data
Session 2: Dr Adeeb Arif Kor	
15:00 – 15:25	Professor Bazhin Vladimir Yurievich Department of Metallurgy, Empress Catherine II Saint Petersburg Mining University Topic: Innovative solutions in the field of metallurgical processes and production of non-ferrous metal alloys modified with rare earth elements
15:30– 15:55	Associate Professor Dr. Meor Hakif bin Amir Hassan Department of Geology, Universiti Malaya Topic: The Geological Characterization of Sedimentary Rocks at Multiple Scales Within Malaysia Basin
16:00 – 16:25	Professor Plotnikova Irina Nikolaevna, Dr. Grokhotov Evgeny Igorevich Problem-Oriented Research Laboratory in Earth Science, Empress Catherine II Saint Petersburg Mining University Topic: Deep Oil and Gas: Problems of Origin, Exploration and Development
16:25 – 17:00	Closing ceremony by Empress Catherine II Saint Petersburg Mining University, Russia

Empowering AI Tools in Training For Human Capital Development in Mining and Quarrying Industries.

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Abstract

Artificial Intelligence (AI) is swiftly revolutionizing the mining and quarrying sectors by improving operational efficiency, safety, and sustainability while tackling significant human capital development issues. This document examines the incorporation of AI tools in training initiatives to prepare employees with the competencies required to manage progressively intricate and technologically sophisticated settings. AI technologies like machine learning, computer vision, and robotics are transforming essential mining processes such as geometallurgy, exploration targeting, grade control, and predictive maintenance. These technologies facilitate immediate data evaluation, enhance equipment efficiency, and minimize environmental consequences. Nevertheless, the sector encounters considerable training obstacles such as dangerous work environments, demands for specialized skills, high employee turnover, and swift advancements in technology. To address these challenges, AI-driven training tools like virtual reality (VR) simulations, intelligent monitoring systems, adaptive learning platforms, and virtual assistants are implemented to facilitate engaging, tailored, and secure educational experiences. These tools enhance knowledge retention and compliance while equipping workers for real-world situations without facing risks. Moreover, automation powered by AI in crushing and grinding operations greatly minimizes energy use and improves the lifespan of equipment by means of immediate optimization and fault identification. As AI advances, its involvement in workforce training will grow, possibly resulting in entirely automated, VR-driven training settings linked with operational systems. This transition guarantees lower training expenses, enhanced productivity, and a highly proficient workforce ready to adapt to upcoming technological progress. The study finds that enhancing human resources via AI-based training is crucial for preserving competitiveness and sustainability in the mining and quarrying industries.

Keywords: Artificial Intelligence (AI), Human Capital Development , sustainable mining and quarrying

Locking Carbon in Stone: Enhancing CO₂ Storage with Natural Surfactants

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Abstract

For decades, fossil fuel utilization has driven economic growth but at the expense of severe environmental consequences, primarily the excessive emission of carbon dioxide (CO₂), which accelerates global warming. In response, global efforts now focus on reducing greenhouse gas emissions and transitioning toward a low-carbon society. Among the most promising mitigation strategies is geological CO₂ storage, which entails capturing CO₂ at its source, transporting it, and injecting it into suitable subsurface formations. The principle of CO₂ storage mirrors that of natural hydrocarbon reservoirs, where fluids are trapped in porous rock formations. At reservoir pressures and temperatures, CO₂ exists in liquid or supercritical states, reducing its volume and enabling efficient storage. The global storage potential is vast, estimated at around 2,000 gigatonnes, which is nearly 80 times the annual global emissions. Potential storage sites include depleted oil and gas reservoirs, deep saline aquifers, and gas-hydrate formations. Storage efficiency and security depend on reservoir properties such as porosity, permeability, pressure, temperature, and the sealing integrity of the caprock. CO₂ is ultimately immobilized through a combination of residual, solubility, and mineral trapping mechanisms. A critical factor influencing these mechanisms is wettability, which governs CO₂ migration, trapping efficiency, and long-term stability. Experimental studies consistently show that rock wettability strongly affects CO₂ storage capacity. Recently, natural surfactants have attracted attention as agents for wettability alteration. These amphiphilic compounds can adsorb onto rock surfaces, shifting wettability toward more water-wet conditions, thereby enhancing capillary trapping and reducing leakage risks. In addition, natural surfactants offer environmental compatibility, though challenges remain in ensuring stability under high-pressure, high-salinity conditions and achieving cost-effectiveness compared to synthetic alternatives. Integrating natural surfactant-based wettability modification into CO₂ storage strategies could substantially enhance storage integrity, security, and long-term performance, advancing the transition toward safer and more sustainable carbon management.

Keywords: Geological CO₂ storage; Wettability alteration; Natural surfactants; Residual trapping

The Geological Characterization of Sedimentary Rocks at Multiple Scales within Malaysian Basin

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Abstract

Characterization of ancient sedimentary rocks is very important in the context of hydrocarbon exploration and production in Malaysian sedimentary basins. Such geological work uses fundamental concepts and methods in sedimentology, stratigraphy, ichnology, petrography etc. and is done at various scales. Several examples of such studies at different scales are shown from around Malaysia, including onshore as well as offshore basins. Outcrop-based studies from the Neogene of Sarawak involve traditional facies analysis and geologic mapping techniques as well as digital 3D outcrop models to understand marginal marine sandbody dimensions, geometries, orientation and heterogeneity. The results are used as analogues for hydrocarbon-bearing reservoir sandbodies of similar age and provenance in offshore Sarawak Basin, which are studied using conventional cores and well logs. A similar method is currently being used on older (Palaeozoic) rocks in NW Peninsular Malaysia, which are providing clues on the geology and stratigraphy of the poorly understood and relatively unexplored Langkasuka Basin, offshore Strait of Malacca. At the larger scale, studies of 3D seismic reflection data acquired from the subsurface can be used for the identification of distinct sandbody geomorphologies such as channels, bars, turbidite lobes etc. Cores penetrating the studied stratigraphic intervals, integrate with well log data can be used to support interpretations of these sandbodies. An example study from the Miocene Malay Basin is shown. Geological characterization is also done at the microscopic scale, using a combination of traditional tools such as a petrographic microscope for describing mineralogy and texture as well as Micro-computed tomography, which can be used for characterization of porosity and permeability. The methods, which have been very essential for oil and gas reservoir studies, are also applicable for CO₂ sequestration efforts in Malaysia, and our current target is for future projects in this topic, which while require collaboration with expertise in geochemistry and mineralogy.

Keywords: Geological characterization, Sedimentary rocks, Malaysian basins, Hydrocarbon exploration, Multi-scale analysis

Potentiality of Rare Earth Elements (REEs) Business Investment in the State of Kedah, Malaysia

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Abstract

Rare Earth Elements (REEs) are vital to modern technologies, including renewable energy, electronics, and defense systems. The growing global demand for REEs has prompted renewed interest in exploring new sources. Kedah, a northern state in Malaysia, has recently been identified as a potential location for REE mining, particularly ion-adsorption clay deposits similar to those found in China. This positions Kedah as a strategic player in the global REE supply chain. This study examines the potential for REE business investment in Kedah, focusing on geological prospects, policy support, infrastructure, and environmental considerations. Malaysia's National Mineral Industry Transformation Plan 2021–2030 encourages sustainable mining and provides incentives for responsible investment, enhancing the viability of REE projects in the state. Kedah's access to transportation networks, skilled labors, and political commitment further strengthen its investment appeal. However, environmental and social concerns remain significant. REE extraction can cause serious ecological harm if not managed responsibly. Therefore, any development must emphasize sustainable practices, strict environmental compliance, and transparent stakeholder engagement. In conclusion, Kedah presents promising opportunities for REE business investment, provided that it balances economic gains with environmental protection and social responsibility.

Keywords : Rare Earth Elements (REE), Business Investment, Mining, R&D, Supply Chain

Rare Earth Elements in Malaysia, Upstream and Downstream

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Abstract

Malaysia holds strategic reserves of rare earth elements (REEs) with significant potential for applications in semiconductors, renewable energy, green technology, and advanced manufacturing. Despite this advantage, challenges persist in mining techniques adapted to local geology, efficient separation technologies, and downstream processing for high-value products such as permanent magnets. The Centre of Excellence for REE Research at Universiti Malaya addresses these gaps through integrated upstream, midstream, and downstream initiatives, supported by stakeholder engagement with government agencies, industry, and international collaborators. Ongoing research includes the development of sustainable in-situ leaching methods, characterization and separation of Malaysian REE carbonate, and recovery of REE from e-waste using hydrophobic deep eutectic solvents. Complementary projects explore the doping of proton-conductive perovskites with REEs to enhance the performance of solid oxide fuel cells, demonstrating the broader energy applications of REE-based materials. These initiatives emphasize sustainability, regulatory compliance, and environmentally responsible processing. Future directions include collaborative research with Russia on advanced magnetic powders, alloy optimization, and sustainable magnet manufacturing, supported by Malaysia's Strategic Research Fund. Collectively, these efforts aim to establish Malaysia not only as a resource supplier but as a regional hub for REE innovation, processing, and commercialization, contributing to global supply chain resilience and technological advancement.

Keywords: Rare Earth Elements (REE), Sustainable mining, E-Waste recovery, Magnetic Materials

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