



The First Higher Technical University in Russia
EMPRESS CATHERINE II
SAINT PETERSBURG
MINING UNIVERSITY



Centre
Under the auspices
of UNESCO



International Competence Centre
for Mining-Engineering Education
under the auspices of UNESCO

Proposal of the Mining University on Joint Implementation of Scientific, Technical and Production Projects for the Development of the Mineral Resource Complex of African Countries within the Framework of the Russian-African Raw Materials Dialogue

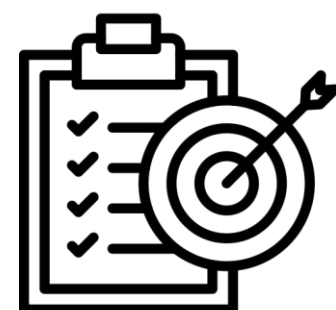
Joint Implementation of Integrated Projects for the Development of the Mineral Resource Complex (MRC), Economy and Mineral Resource Policy of African Countries



The African continent holds 30% of the world's mineral reserves, that create enormous potential for sustainable economic growth. However, this potential can only be realised through national sovereignty over mineral resources and the development of domestic workforce for the MRC.



Saint Petersburg Mining University proposes joint implementation of scientific, technical and production projects that comprise a set of research, technological and organisational measures covering all elements of the MRC: exploration, appraisal and evaluation of deposits, extraction, beneficiation, processing, marketing of final products and industry management.



Objective of cooperation

Technology transfer and experience exchange through joint implementation of integrated scientific, technical and production projects for the development of the MRC, while building the most comprehensive technological chain across different levels of project implementation.



- ! Mineral exports account for ,on average, of **70%** of Africa's total exports and about **28%** of its GDP.
- ! Shortage of national qualified managers and specialists at MRC enterprises is **60%**.
- ! **Lack of integrated projects** covering the entire technological chain from exploration to the sales of final processed products on global markets
- ! A track record of successful cooperation has been established between the Mining University and African countries within the framework of the **MBA programme "Subsoil – Mineral Resources Management"**

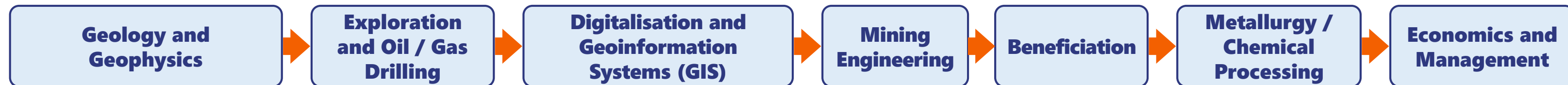
Project Architecture

Project objective is defined by the partner based on national priorities and the development strategy of the country



Objects of study are specific natural and industrial facilities

- ❗ Due regard for unique characteristics of natural systems;
- ❗ Due regard for local infrastructure features;
- ❗ Due regard for national legal and regulatory framework.



**Work of specialists
in interdisciplinary teams**
(4–5 representatives from each side)



Training of an “integrative engineer-manager” – a specialists who combines a deep engineering understanding of technological processes with competences in strategic industry management

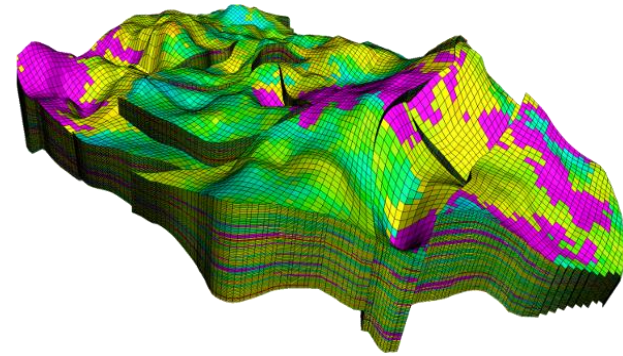


Accelerated technology adoption
Rapid transition from scientific concept to industrial implementation through the work of small interdisciplinary teams directly at the real-life facilities.



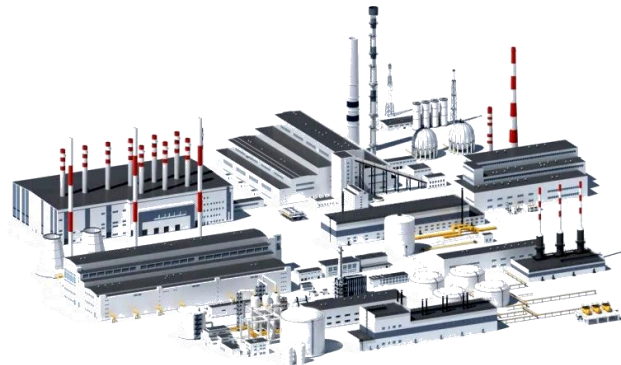
Political and economic integration with the national strategies of mineral resources development, embedding in the legal framework of the countries, and creating a tool for strengthening state sovereignty over resources.

Levels of Project Implementation



Mineral Resource Objects

(ore clusters, deposits, oil-and-gas basins, shelf zones, dumps and tailings of processing plants)



MRC Facilities

(mining/ extraction industry: open-pit mines, underground mines; beneficiation and refining facilities)



Strategic Management in the MRC

(legal regulation, economy of mineral resources management, sustainable use of mineral resources)

Geology

Geophysics

Exploration and Oil / Gas Drilling

Digitalisation and GeoInformation Systems (GIS)

Mining Engineering

Beneficiation/ Refining

Metallurgy / Chemical Processing

Economics

Management



Implementation Level: Mineral Resource Objects

Geology

- Mapping and structural-tectonic analysis of ore fields;
- Study of geochemistry, mineralogy and genesis of mineralisation;
- 3D modelling of deposits and resource estimation;
- Identification of exploration criteria for unconventional ore types.

Geophysics

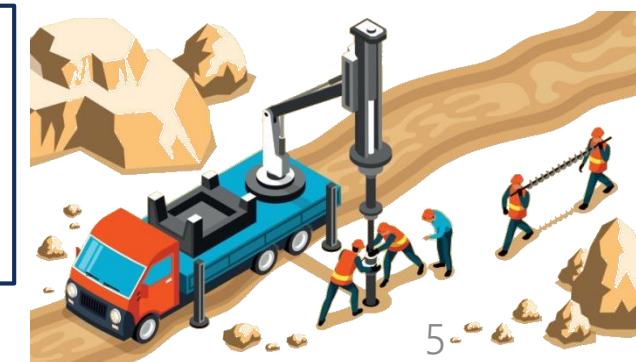
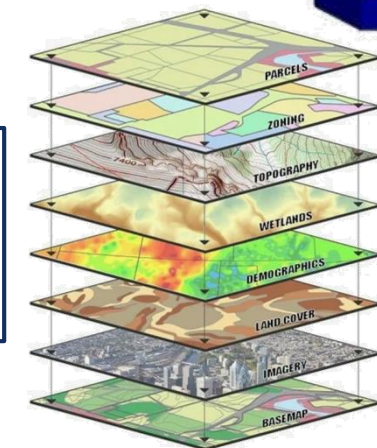
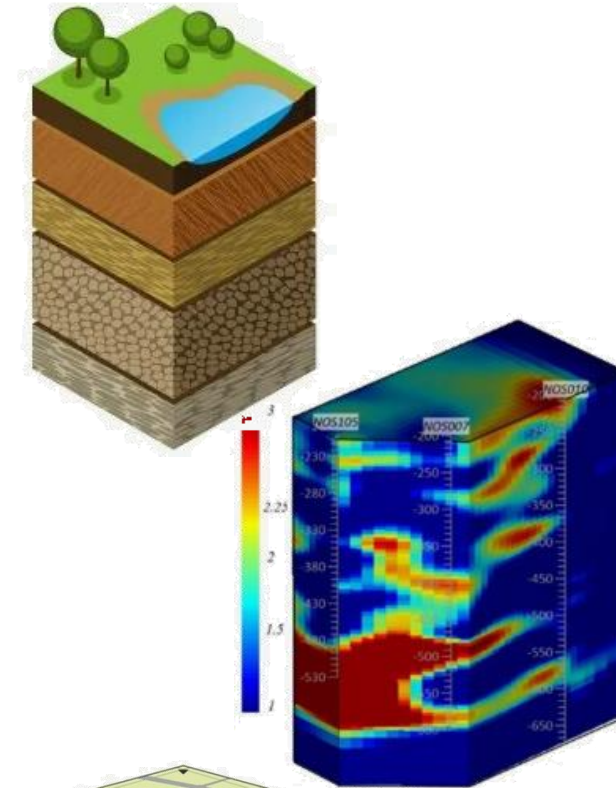
- Integration of magnetic, gravity, electrical prospecting and seismic methods;
- Processing and interpretation of geophysical fields using machine-learning algorithms;
- Refinement of deep structure of prospective areas.

Exploration and Oil / Gas Drilling

- Design of optimal drilling programmes for specific geological tasks;
- Supervision and quality control of drilling operations, core logging, sampling for laboratory studies and process testing.

Digitalisation and GeoInformation Systems (GIS)

- Creation of a unified digital platform for the geo data of the territory;
- Digitisation and storage of archival geological and geophysical data;
- Modelling of ore fields based on multi-layer analysis (remote sensing, geology, geochemistry, geophysics).



Implementation Level: MRC Facilities

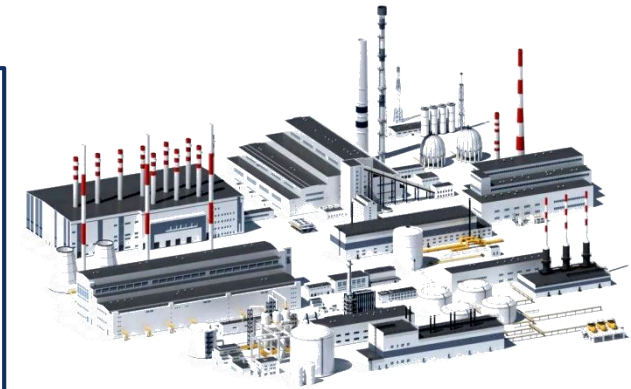
Mining Engineering

- Rock mechanics substantiation of extraction parameters;
- Design of deep-level operations with ground pressure and thermal regime management;
- Implementation of automated and robotic extraction systems.



Beneficiation

- Development and optimisation of ore preparation and separation flowsheets;
- Application of gravity, magnetic, flotation and optical methods;
- Laboratory and pilot testing to evaluate recoverability of valuable components.



Metallurgy / Chemical Processing

- Hydro- and pyrometallurgical processing of concentrates;
- Production of marketable products (ingots, lithium carbonate, "green" steel);
- Recovery of associated valuable components (REE, scandium, vanadium).



Implementation Level: Strategic Management in the MRC

Economics

- Feasibility studies for mining project conditions and investments;
- Mineral market analysis and price forecasting;
- Construction of financial models and risk assessment.

Management

- Strategic planning for the development of the mining sector;
- Management of interdisciplinary projects and international teams;
- Logistics, transport corridors and implementation of ESG standards.



Examples of Potential Joint Scientific and Technical Projects Reflecting the Development Priorities of the Mineral Resources Complex of African Countries

Mineral Resource Objects

- National programme for digitalisation of geological data, resource prediction and preliminary exploration using AI (regions with developed exploration infrastructure);
- Search and appraisal of unconventional mineral sources using machine learning on geological and geophysical data (Kimberlite provinces of Southern and Central Africa);
- Exploration and extraction of continental shelf minerals using geophysical mapping and autonomous underwater vehicles (coastal waters of the Atlantic).

MRC Facilities

- Integrated processing of historical dumps and tailings with recovery of residual gold, platinum, chromium, uranium and associated REE (old mining centres in Southern and Eastern Africa);
- Development of ultra-deep horizons (>2–4 km) of deposits: robotic extraction, ground pressure and thermal regime management (ore districts of South African cratons);
- Creation of a local cluster for deep processing of pegmatite raw materials: from ore to battery materials (pegmatite belts of Eastern and Southern Africa).

Strategic Management in the MRC

- Development of a strategy / roadmap for the national mining and geological survey (countries with large resource potential but weak regulatory systems);
- Multi-disciplinary feasibility study and designing of transport corridors to unlock the mineral potential of remote provinces (transcontinental corridors linking Central and Southern Africa to ocean ports);
- Establishment of national refining and cutting centres to retain added value within the country.



A mandatory condition for Africa's emergence as a future global centre of economic development is the sovereignty of the African nations, which depends on establishing control over the extraction and processing of their own mineral resources. In turn, control and development of the mineral resource complex are possible only with full domestic staffing of the extractive and processing industries.

V. Litvinenko

Advantages of Cooperation



Control over resources and geodata – the country retains ownership of geological data, digital models and management decisions.



Increasing the revenues from sectoral industries– creation of an integrated cycle from exploration, deposit development and mineral processing to final product sales, with added value retained within the country.



Staffing empowerment– training of managers and engineers with high competences for all stages of mineral resource management, from geology to economic implementation.





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