Online ISSN : 3049-3455

Mineral Metal Energy Oil Gas and Aggregate

Contents available at: www.informaticsjournals.co.in/index.php/2MEOGA

The USA could be Blindsided in its Rush to Acquire the Ukrainian Critical Minerals Deposits

Jayanta Bhattacharya

Former Professor, Department of Mining Engineering, Indian Institute of Kharagpur, Kharagpur - 721302, West Bengal, India; jayantaism@gmail.com



Ukraine possesses significant reserves of critical minerals essential for modern industries and the global transition to green energy. The country's geological foundation, known as the "Ukrainian Shield," is rich in various mineral deposits. However, the key concerns are: what is the reserve-to-resource ratio? Are they Metallurgical grade? What is the depth of the deposits? What will be the method of mining? What will be the metal recovery ratio? In a hurry, to prove a point, most of the time these basic details are ignored and lost in descriptions. Let us dig further.

Lithium Deposits

a. **Shevchenkivske Deposit**: Located in the Donetsk region, this deposit contains high concentrations of spodumene, a primary lithium-bearing mineral used in battery production, with reserves estimated at 13.8 million tonnes of lithium ore.

b. **Polokhivske Deposit**: Situated in the Kirovograd region, this site is considered one of Europe's best lithium sources due to favorable geological conditions, with approximately 270,000 tonnes of lithium.

Other Critical Minerals

1. **Titanium**: Ukraine ranks as the third-largest global producer of rutile, accounting for 15.7% of the world's output.
2. **Iron Ore**: The country is the sixth-largest producer, contributing 3.2% to global production.
3. **Manganese**: Ukraine holds the seventh-largest manganese ore reserves, with approximately 2.4 billion tonnes concentrated primarily in the Nikopol Basin.
4. **Uranium**: Home to Europe's largest uranium reserves, crucial for nuclear power and weapons.
5. **Rare Earth Elements**: Significant deposits, including neodymium and dysprosium, essential for manufacturing electronics, wind turbines, and electric motors.

Geopolitical Context

The strategic importance of Ukraine's mineral wealth has attracted international interest. Recent negotiations between Ukraine and the U.S. have highlighted the geopolitical significance of these resources. A proposed minerals deal involves Ukraine allocating 50% of future proceeds from state-owned mineral resources to a reconstruction investment fund for post-war rebuilding, jointly managed by Kyiv and Washington.

Challenges

Despite the vast mineral potential, many deposits remain largely unexplored due to ongoing conflicts, which have disrupted mining operations and damaged infrastructure. Additionally, a significant portion of these resources is located in regions currently under Russian occupation, complicating extraction efforts.

In summary, Ukraine's substantial reserves of critical minerals position it as a potential leader in the global supply chain for these essential resources. However, realizing this potential requires addressing geopolitical challenges and securing substantial investments in mining infrastructure and exploration.

Reserve to Resource Ratio and Metallurgical Grade

Below is an overview of the reserve-to-resource ratios and metallurgical grades for key minerals:

1. **Manganese**
   a. **Reserves**: Approximately 2.4 billion tonnes, primarily located in the Nikopol Basin.
   b. **Metallurgical Grade**: The ore grades range from 11% to 35% manganese content, which is considered low to moderate. This necessitates extensive processing to achieve the purity required for industrial applications.
2. **Graphite**
   a. **Reserves**: Estimated at 19 million tonnes of ore, with graphite content ranging from 5% to 8%.
   b. **Metallurgical Grade**: The graphite deposits are of moderate quality, requiring beneficiation to meet the standards for battery production and other industrial uses.
3. **Titanium**
   a. **Reserves**: Approximately 52 million tonnes, accounting for about 7% of the world's total reserves.
   b. **Metallurgical Grade**: The titanium-bearing minerals, such as ilmenite and rutile, are of high quality. However, Ukraine currently lacks the facilities to produce titanium sponge, the form required for advanced industrial applications.
4. **Lithium**
   a. **Reserves**: Confidential estimates suggest potential reserves that could place Ukraine among the top five countries globally for lithium.
   b. **Metallurgical Grade**: The largest potential lithium reserves are found in three sites within the Ukrainian Shield, with ore grades considered moderate to good.
5. **Rare Earth Elements (REEs)**
   a. **Reserves**: Several sites of volcanic origin and associations with uranium deposits indicate potential, though these have not been fully developed or quantified.
   b. **Metallurgical Grade**: Sampling has indicated commercial potential in some sites, particularly for REEs in high demand for superior magnets and electronics, such as neodymium, praseodymium, terbium, and dysprosium.

It is important to note that while Ukraine's reserves are substantial, the quality and accessibility of these minerals vary. Many deposits require significant investment in processing infrastructure to meet industrial standards.

Additionally, ongoing geopolitical challenges may impact the development and exploitation of these resources.

Depth of the Deposits, Method of Mining, and Recovery Ratio

Ukraine's critical mineral deposits vary in depth, mining methods, and recovery rates, depending on the specific mineral and geological conditions. Below is an overview of key deposits:

1. **Lithium Deposits**
   - **Shevchenko Deposit**: Located in Donetsk Oblast, this deposit features lithium-bearing minerals such as spodumene and lepidolite within pegmatite formations. The ore body extends to depths of 150–200 meters, with an average lithium oxide (Li_2O) grade of 1.3–1.5%. These characteristics make it suitable for open-pit mining.
   - **Polokhivske Deposit**: Situated in the Kirovohrad region, this deposit is currently underdeveloped due to ongoing conflicts and security concerns. Experts estimate that it could take at least eight years and substantial investments totalling up to $1.8 billion to commence production. Specific details regarding depth and mining methods have not been disclosed.
2. **Iron Ore Deposits**

Central Iron Ore Enrichment Works (CGZK): Located in Kryvyi Rih, CGZK specializes in processing and producing raw materials for the steel industry. It uniquely employs both open-pit and underground mining methods to extract quartzite fields. The merchant concentrate produced has an average iron (Fe) content ranging from 65.0% to 68.2%, and pellets with an average Fe content of 63.9%. Specific recovery rates are not publicly available.

3. **Gold and Silver Deposits**

Berehove Mine: Located in Zakarpattia Oblast, the Berehove mine is one of Ukraine's largest gold mines, with estimated reserves of 14.4 million ounces of gold and 144 million ounces of silver. The mine also contains ore reserves amounting to 300 million tonnes, grading 1.5% lead and 2.1% zinc. Specific details regarding mining methods and recovery rates are not publicly available (https://en.wikipedia.org/wiki/Berehove_mine?utm_source=chatgpt.com).

4. **Coal Deposits**

Skochinsky Coal Mine: This mine represents one of the largest coal reserves in Ukraine, with estimated reserves of 144.4 million tonnes. Mining operations are conducted at depths of up to 1,200–1,450 meters, making it one of the deepest coal mines in the country. The annual coal production is approximately 776,000 tonnes.

General Mining Methods and Recovery Rates

- **Heap Leaching**: This method is commonly used for extracting valuable metals from low-grade ores. The process involves stacking crushed ore and applying a leach solution to dissolve the target minerals. While heap leaching is cost-effective, it typically has recovery rates of 60–70%.
- **Room and Pillar Mining**: Used for relatively flat-lying deposits, this method involves excavating "rooms" of ore while leaving "pillars" to support the roof. Although it reduces the risk of surface subsidence, the recovery rate can be as low as 40% in some cases (https://en.wikipedia.org/wiki/Room_and_pillar_mining?utm_source=chatgpt.com).

It's important to note that the development and exploitation of these mineral resources are influenced by factors such as geopolitical challenges, infrastructure limitations, and investment requirements. For instance, the ongoing conflict in Ukraine has hindered the development of certain deposits, and substantial investments are needed to establish the necessary infrastructure for mining operations. In a nutshell, while Ukraine possesses significant mineral resources, the depth of deposits, suitable mining methods, and expected recovery rates vary across different minerals and locations. Detailed geological surveys and feasibility studies are essential to determine the most effective extraction strategies for each deposit.

Metallurgy Proven?

The metallurgical viability of these resources remains largely unproven due to several factors:

1. **Outdated Geological Assessments**: Most evaluations of Ukraine's mineral resources date back to Soviet-era studies conducted between the 1960s and 1980s. These assessments utilized exploration methods that are now considered obsolete, leading to uncertainties about the current quality and quantity of these deposits.
2. **Lack of Modern Feasibility Studies**: There is a significant absence of contemporary feasibility studies and metallurgical testing to determine the commercial viability of mining these minerals. Factors such as ore grade, depth, and the presence

of by-products have not been thoroughly analyzed with modern techniques, making it challenging to assess the potential for profitable extraction.

3. **Geopolitical and Infrastructure Challenges**: The ongoing conflict in Ukraine has resulted in the destruction of essential infrastructure, including power generation facilities crucial for mining operations. This situation poses additional risks and uncertainties for potential investors considering the development of these mineral resources.

In summary, while Ukraine's critical mineral deposits hold potential, the lack of modern geological data and metallurgical testing, coupled with infrastructural and geopolitical challenges, means that their economic viability has yet to be established.

Caution

This article is an opinion piece. Refine your judgments by being more aware of the topic from other sources.