**ILLUSORY RARE EARTHS**


3/21/2025

"War is the continuation of politics by other means."
Karl Von Clausewitz '

"Might makes Right."
Rules-based Order

## INTRODUCTION

In a stratagem aiming at luring the USA into a deeper involvement, beyond providing armaments and targeting intelligence to a European alliance seeking the disassembly of the Commonwealth of Independent States CIS into multiple exploitable entities, President Volodymyr Zelensky, as part of an envisioned "Victory Plan", offered the USA to gain access to Ukraine's mineral resources in return for a vague set of "Securities Guarantees." These would prolong the Ukraine/Russia conflict and comprise American Troops involvement with "boots on the ground", and an imposed USA no-fly zone over the Ukraine, joined by contingents of British and French troops.

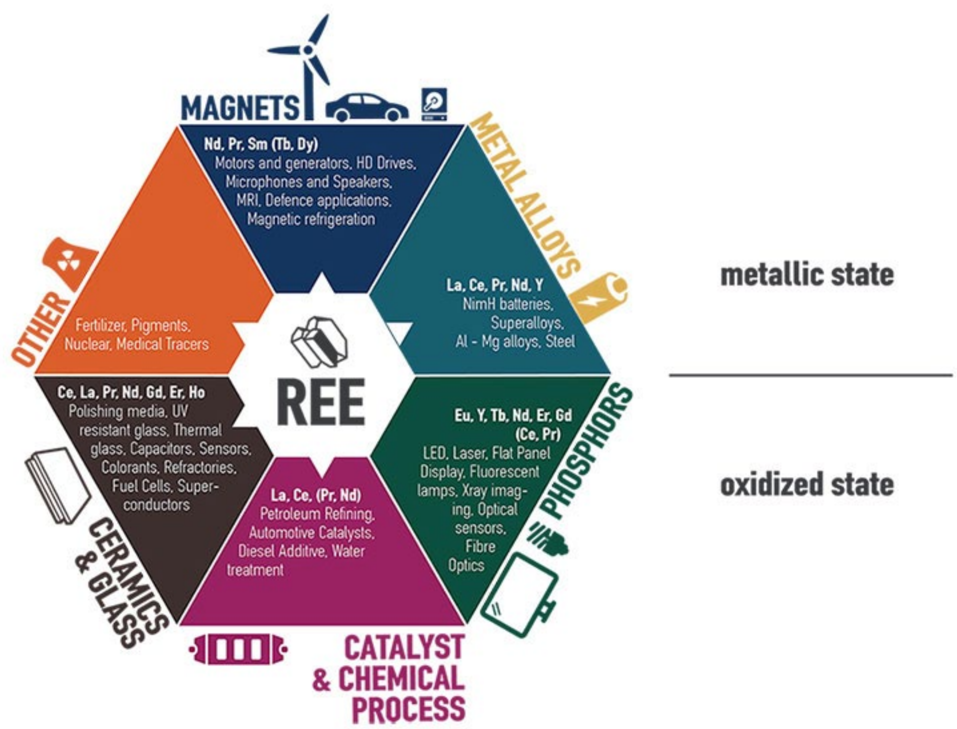


Figure 1. Rare Earths Elements REEs uses in modern technology.

**UKRAINE/USA MINERAL DEAL**

President Donald Trump gleefully jumped on the proposal and transformed it into his own perspective for a deal that would grant the USA exclusive access to Ukraine's Rare Earths Elements, REEs in exchange for continued military support, but excluding the vague demanded "Securities Guarantees," opting instead for a quick genuine peace settlement of the Ukraine/Russia conflict. He was probably generous enough trying to throw Ukraine a lifeline, since the USA has available ample reserves of these elements [1, 2].

The USA administration indicated that American troops could be deployed to provide security in connection with the minerals if there is a peace deal with Russia. The USA authorities denied permits to the Rio Tinto Group to mine REEs in Alaska and Arizona despite a spending of $3 billion on sites exploration.

The USA officials had pitched the deal as an integral part of a genuine lasting peace in resolving the multi-year war between Russia and Ukraine. President Donald Trump and top USA officials have articulated that the USA requests a guarantee of an exaggerated $500 billion, maybe realistically $150 billion, worth of Ukraine's supposedly estimated trillion dollars of Rare Earths Elements wealth.

A historical precedent is that the USSR/Russia repaid the USA World War II Land Lease loans of $722 million in 1972, and the debt was settled in 2006.

President Volodymyr Zelenskyy envisions American and European security guarantees to be tied directly to any deal on the mineral reserves, including veiled language attempts at providing nuclear devices to the Ukraine. The USA's administration attempted to recoup USA loans losses from the war that is contributing to a USA ballooning crippling budget deficit by seeking a substantial stake in Ukraine's Rare Earths minerals deposits. The interest of the USA in these strategic materials is meant to counter China's controlling the supply chain of such a vital resource. However, experts agree that these Ukraine's Rare Earths mineral deposits are an illusory pie in the sky. In addition, the USA possesses ample reserves of these ores that are lightly exploited or partly exported as concentrates for refining elsewhere.

On February 12, 2025 USA Treasury Secretary Scott Bessent presented President Volodymyr Zelensky with a draft of a minerals cooperation agreement. The deal called for 50 percent of Ukraine's resulting mineral and natural resources revenues to go to the USA as payment for previous military support for the war against Russia. This would include not only revenues from Rare Earths' mining but the "entire economic value associated with resources in Ukraine including uranium, lithium, oil, gas, and even some port revenues. The deal also specified that USA companies must hold 50 percent ownership of Ukraine's Rare Earths elements deposits. The deal would override all of Ukraine's other trade agreements.

President Volodymyr Zelensky refused to sign the agreement as it included no Security Guarantees for Ukraine. President Donald Trump has said he wants $500 billion worth of Ukrainian minerals as compensation, but President Volodymyr Zelensky claims that USA military aid has totaled nowhere close to $500 billion. A second, less binding memorandum of understanding was presented days later by Vice President J. D. Vance and Secretary of State Marco Rubio. President Volodymyr Zelensky reportedly responded that he could not sign the agreement without approval from his Parliament.

**MASSIVE LOSS OF FACE, ALREADY COMMITTED RESOURCES**

According to the Center for Strategic and International Studies, the Ukraine/USA agreement would have established "A reconstruction investment fund with joint USA and Ukraine ownership. Ukraine will contribute 50 percent of all revenues earned from the future monetization of all Ukrainian government-owned natural resource assets into the fund."

Ironically, circulated information is that the access to Ukraine mineral resources was already promised to the UK in exchange for a naval base to be built at the port city of Odessa on the Black Sea. The Odessa UK naval base in Odessa is part of an extensive menu of Ukraine's resources already, in thesis, handed over to the UK under a shady 100-year signed agreement.

According to the deal and its footnotes, President Volodymyr Zelensky already hypothecated to the UK all sorts of controls over minerals, nuclear power plants, underground gas storage facilities, key ports including Odessa, and hydroelectric power plants.

Regarding the subset of minerals/rare earths deal, the UK beat the USA to the punch and became involved in a vicious, direct competition. "This whole thing will turn very ugly in no time."

**UKRAINE MINERAL RESOURCES**

What Ukraine is endowed with is rich productive farmland, making it a major grain, particularly wheat and corn producer and exporter to the rest of the world. It is rich in iron ore and coal, but it has only a few small mines of a single peripheral Rare Earth Element: Scandium Sc. There exist four main deposits: Yastrubetske, Novopoltavske, Azovske, and Mazurivske. Two of the deposits are dominated by a mineral named Britholite which is not desirable because it has not been processed for Rare Earths. Almost nothing exists in the way of process chemistry and equipment.

The USA Geological Survey USGS, an authority on the matter, does not list the country as holding any substantial REEs reserves. Neither do other data bases used in the mining industry.

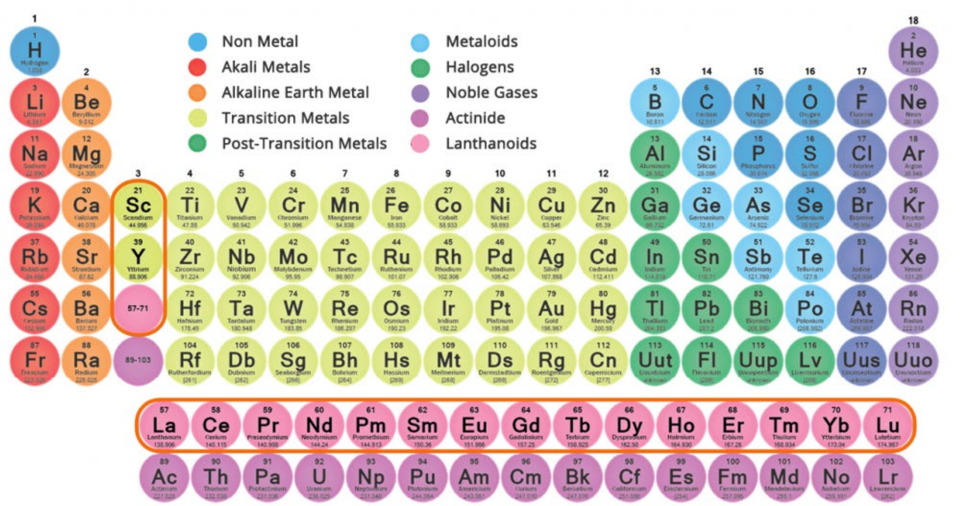


Figure 2. The REEs are a group of 17 elements composed of the 15 Lanthanides elements in the Periodic Table of the Elements in addition to Scandium Sc and Yttrium Y being transition metals which have similar properties.

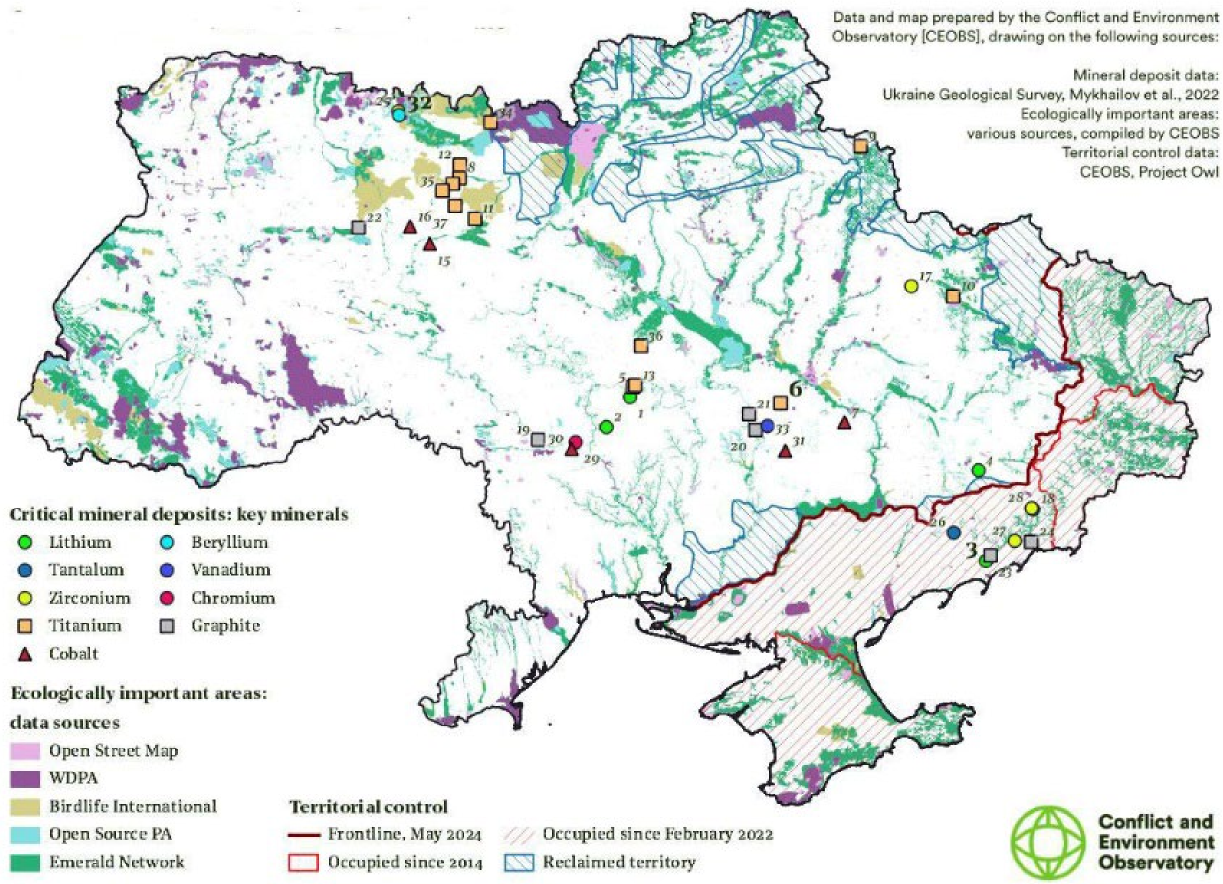


Figure 3. Mineral resources of the Ukraine. Source: Conflict and Environmental Observatory.

Other limited mineral resources of Titanium Ti, Gallium Ga, Lithium Li, Beryllium Be, Tantalum Ta, Zirconium Zr , Cobalt Co, Vanadium V, Chromium Cr and Graphite C do exist in the Ukraine.

The value of all the world's Rare Earths' production is about $15 billion per year, not the trillions of dollars envisioned. This would be the value of two days of global petroleum output.

According to Javier Blas [6]:

> "Maybe Trump conflated "rare earths" with the much broader concept of "critical minerals." Of the latter, Ukraine has some commercial mines of titanium and gallium. Both are fairly valuable and have some strategic importance, but then again, controlling either would not alter geo-economics. And they certainly aren't worth Trump's expressed $500 billion.
>
> Still, the American president steadfastly referred to rare earths; not once, but several times. So then, perhaps he knows something the commodity world does not. But I found no credible source that says Ukraine is brimming with reserves.
>
> Every document someone has pointed out to me regurgitates the same conspiracy-theory claims found on the blogosphere. They tend to mistake accumulations of some rare-earth-bearing minerals as equating with a commercial

mine. Many highlight the Novopoltavske deposit, discovered by the Soviets in 1970, as a potential source. While tiny amounts of rare earths are present there, digging them out seems impossible — hence why the site remains an unproductive deposit rather than a mine more than 50 years after its discovery. The Ukrainian government has described Novopoltavske as "relatively difficult" to mine and said that any rare-earth yield would be "off balance," meaning that it's not economical to exploit them at current prices. Worse, the mineralogy goes against it: The host source is a mineral that makes extracting the elements very hard."

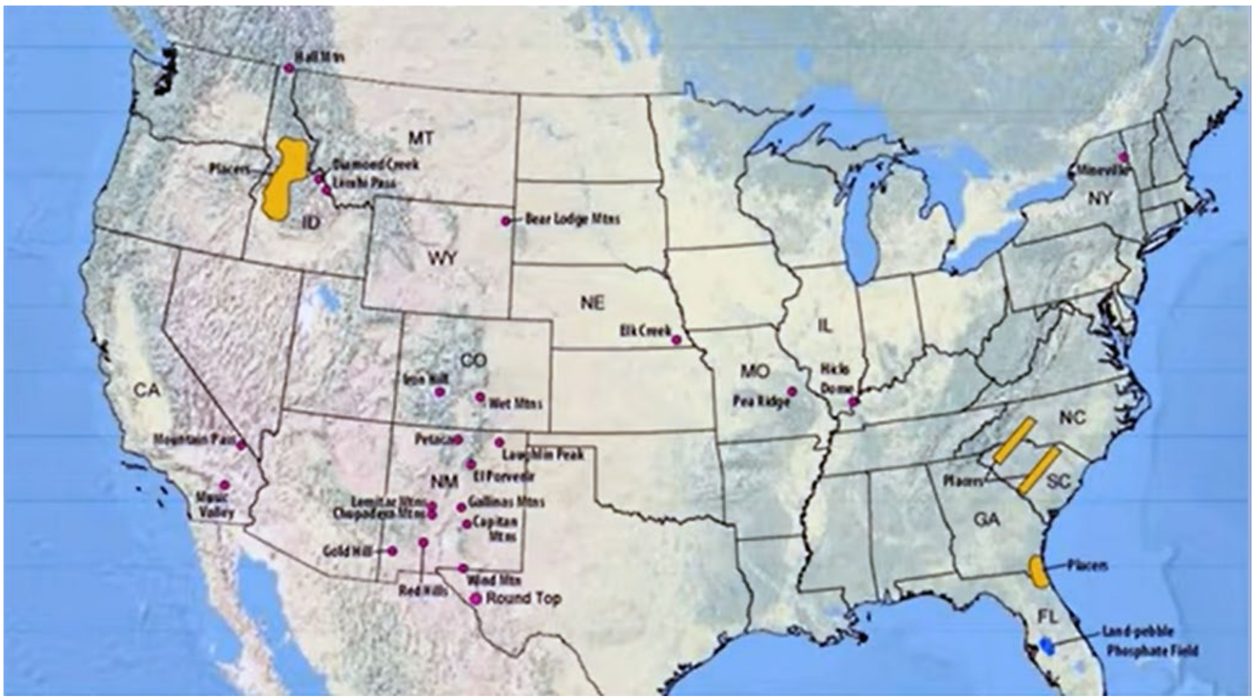


Figure 4. The USA has substantial deposits of rare earth ore, in California, Alaska, Wyoming, Georgia, Arizona and Texas, among other places. The USA is endowed with substantial occurrences of Rare Earths elements as Carbonites and Bastnaesite ores at Mountain Pass, California, as well Monazite ores in Black Sands in Idaho, and North and South Carolina. Also, at numerous locations such as in Iron ores deposits in Missouri and at Hick's Dome, Illinois as well as in Salmon Bay and Bokan Mountain in Alaska. The deposits are associated with the occurrence of radioactive Cerium, Thorium, and other radioactive isotopes posing a radioactive tailings disposal environmental concern.

## RARE EARTH ELEMENTS

"Rare Earths" comprise the 15 Lanthanides elements part of the periodic Mendeleev Table of the Elements, in addition to similar transitive metals Yttrium and Scandium for a total of 17 elements. They are Scandium Sc, Yttrium Y, Lanthanum La, Cerium Ce, Praseodymium Pra, Neodymium Nd, Promethium Pr, Samarium Sm, Europium Eu, Gadolinium Gd, Terbium Ter, Dysprosium Dys, Holmium Ho, Erbium Er, Thulium Thu, Ytterbium Yt, and Lutetium Lu [1].

Figure 5. Rare Earths concentrates. Clockwise from top center: Praseodymium Pra, Cerium Ce, Lanthanum La, Neodymium Nd, Samarium Sm and, Gadolinium Ga.


Figure 6. Rare Earths compounds samples. Cerium oxide, Bastnaesite ore concentrate, Neodymium oxide, Lanthanum carbonate. Source: Molycorp corporation.

They are not rare, but they are hard to extract and to refine. There are deposits of the Rare Earths all over the globe, in multiple forms including in the USA. Some are more common than Lead Pb. They tend to be spread in small quantities and mixed together or with other minerals such as in black sands' Monazite. Large deposits are uncommon and costly to extract.

The problem is in extraction and its feasibility. In the USA one of the biggest hindrances is regulation and environmental restrictions. Cerium Ce, a common Rare Earth Element, is radioactive, albeit with a long half-life, hence low activity. Some of their isotopes are radioactive. Ores also come mixed with Thorium Th which is radioactive.

Processing Rare Earths involves the use of solvents, which can produce toxic waste that pollutes soils and water supplies. More environmentally friendly technologies need to be developed.

Cerium Ce and Lanthanum La are the most common REEs. Cerium Ce is very hard and is used in polishing lenses in optical equipment and lighting. Cerium Ce, even though radioactive, is notably hard and is used in cigarette lighters starters and in catalytic converters, which reduce Internal Combustion Engines ICE's emissions. Neodymium Nd, Dysprosium Dy and

Praseodymium Pra are prominently used in permanent magnets in Electric Vehicles, EVs motors and wind turbines electrical generators.

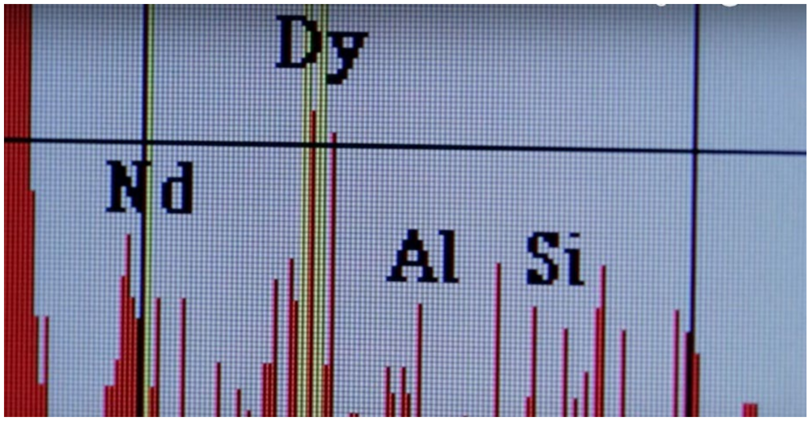


Figure 7. Permanent magnets elemental composition includes Neodymium Nd, Dysprosium Dy, as well as Aluminum Al and Silicon Si.

They are used in consumer electronics, phones, Electric Vehicles, aircraft engines, medical equipment, oil refining, and military applications such as drones, missiles and radar systems.

China exploited the occurrences of the Rare Earth Elements in the open pit mining of Iron ores. China developed the sophisticated extraction and refining industrial capability. Few other nations have similar skills, technology, and ability. In addition, environmental regulations block the industrial extraction process.

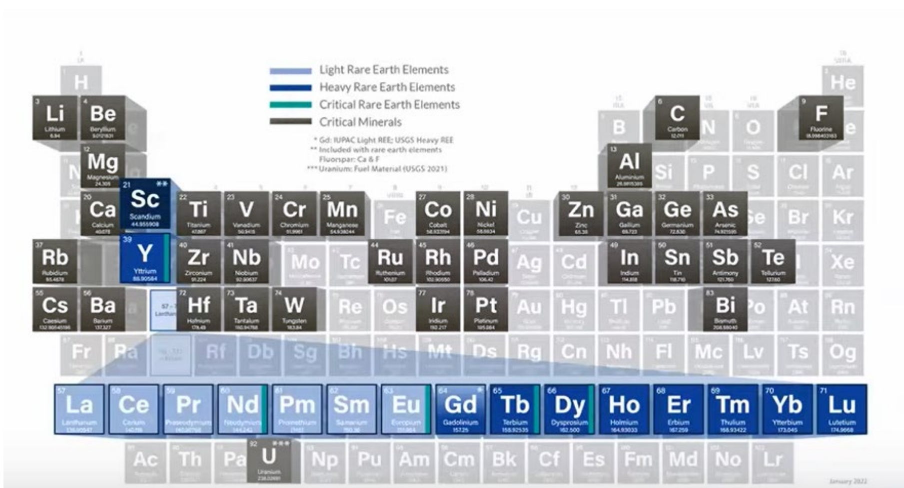


Figure 8. Critical elements other than the Rare Earths Elements. Scandium Sc, Yttrium Y are transition metals elements and are added to the Lanthanides Rare Earth Elements group. The Heavy Rare Earths elements HREEs: Sc, Y, Ga, Tb, Dy, Ho, Er, Tm, Yb and Lu are rarer and more desirable compared with the lighter group LREEs: La, Ce, Pr, Nd, Pm, Sm, and Eu. Some elements in the Lanthanides group have radioactive isotopes such as Cerium. The Actinides group is all radioactive elements.

## UKRAINE CRITICAL ELEMENTS DEPOSITS

Ukraine has deposits of 22 of the 50 minerals classified as “critical elements” by the USA government and has significant deposits of lithium, graphite, titanium, uranium used to generate nuclear power, alongside Rare Earths Elements.

According to Ukraine's Institute of Geology, Ukraine is endowed with large deposits of minerals, including Lanthanum, Cerium, Neodymium and Yttrium. Detailed data about those reserves is classified. Ukraine produces Titanium and it has extensive Graphite and Lithium deposits.

Ukraine’s Polokhivske undeveloped Lithium deposit, managed by the UkrLithiumMining Company is one of the largest in Europe. It is located 240 km or 149 miles northwest of the border with Russia. The deposit is deep and may require up to $800 million just to construct the mine and concentrator Another $1 billion investment would likely be needed to produce the Lithium compounds needed for Lithium-ion batteries.

The company eventually planned to produce about 1.5 million metric tonnes of raw ore per year and process that into 300,000 metric tonnes of Petalite concentrate, a richer Lithium ore. With an additional investment, the concentrate could be further refined to produce 22,000 metric tonnes of battery-grade Lithium carbonate.

As lasting peace returns to the Ukraine, the UkrLithiumMining Company needs to raise $350 million and requires at least 1.5 years to conduct a feasibility study before it can start building a mine and enrichment plant at the site. Reaching steady state production can take five years in duration.

Most Lithium deposits in Ukraine were identified during the USSR era and were not updated or explored since. “Turning Ukraine's reserves of Lithium and Rare Earths into operating mines and constructing processing facilities is a mammoth undertaking.” New frontier development, discovery to delivery of material could take up to 10 years.

## CHINA RARE EARTHS RESOURCES

China is already the world's third-largest Lithium producer, after Australia and Chile. It is also the world's top producer of Rare Earth Elements, which include Neodymium Nd used to manufacture permanent magnets. China developed the occurrences of the Rare Earth Elements in the open pit mining of Iron ores.

Figure 9. China exploited the occurrences of the Rare Earth Elements in the open pit mining of Iron ores.

The USA Geological Survey, USGS, does not provide details of Lithium production in the USA. It is estimated that 45,000 metric tons of Rare Earths Oxides in mineral concentrates were produced in the USA, which would make the USA the second-largest concentrate producer after China.

According to the USGS, China mined 270,000 metric tons of Rare Earths Elements in 2024 or 69 percent of the global total. China has tight expertise over the processing of Rare Earths, a complex and potentially polluting process.

USA companies, such as defunct Molycorp, is now succeeded by MP Materials in Mountain Pass, California, that mines Rare Earths minerals and exports part of the produced concentrate to be refined. China produces more than 90 percent of the world's Rare Earths products.

China has built at least 50 Rare Earths separation plants in the last 10 years. For comparison, outside of China, there are only three separation facilities capable of producing Rare Earth Oxides on an industrial scale. One is at Mountain Pass, USA; another is the Silmet factory in Sillamäe, Estonia, which is owned by Toronto-based Neo Performance Materials; and the third is the large Lynas advanced materials plant, near Kuantan in Malaysia, subject to closure due to public objection to environmental tailings disposal issues. Another Lynas facility, in Kalgoorlie, Australia, produces a mixture of Rare Earths carbonates that can be turned into industrially useful oxides at customer sites, including the USA.

**MP MATERIALS' MOUNTAIN PASS MINE, USA**

USA Rare Earths miner MP Materials went public in a $1.47 billion deal by merging with a private-equity backed blank-check company, underscoring Wall Street's rising interest in efforts to boost production of the strategic minerals in the USA.


Figure 10. Mountain Pass REEs mine and processing plant, Mojave Desert, Southeast California, USA.

MP Materials, listed on the New York Stock Exchange would be the first for a USA Rare Earths company since Molycorp (Molybdenum Corporation of America) went public a decade earlier. Molycorp filed for bankruptcy in 2015 and MP Materials bought California's Mountain Pass mine and other Molycorp assets in 2017.

MP Materials owns and operates Mountain Pass, the only integrated Rare Earths mining and processing site in North America. The open pit mine of Rare Earths elements lies on the south flank of the Clark Mountain Range in California, 53 miles southwest of Las Vegas, Nevada. In

2020 the mine supplied 15.8 percent of the world's Rare Earths production. It is the only Rare-Earths mining and processing facility in the USA.

MP Materials delivers approximately 15 percent of the global Rare Earths supply with a long-term focus on Neodymium-Praseodymium (NdPr), a crucial input to the permanent magnets powering of electric vehicles, wind turbines, drones, robots and many other advanced technologies.


Figure 11. Carbonatite ore, Bastnasite ore $Ce(CO_3)F$ Mountain Pass, California, Bastnaesite crystals, Zagi Mountain, Pakistan.

The Mountain Pass deposit, including the Birthday Claims and Sulphide Queen Carbonatite, was discovered in 1949. In 1952 Molybdenum Corporation of America, Molycorp begun Rare Earth production at Mountain Pass after purchasing the recently discovered claim. In the 1960s production greatly expands at Mountain Pass to supply Europium, used to produce the red fluorescent phosphor in color televisions.

In 1977 the Unocal Oil Company acquired Mountain Pass but suspends mining in 2002. Chevron Oil acquired Unocal in 2005. In 2008 Mountain Pass is acquired by an investor group. In

2010 Project Phoenix a larger than $1.5bn investment and modernization program begins at Mountain Pass. In 2015 Mountain Pass is idled; investment manager JHL Capital Group acquires a controlling position in the Mountain Pass estate.

In 2017 MP Materials is created by JHL and QVT Financial to acquire Mountain Pass and restore it as one of the premier global materials operations. In 2017 mining operations are restarted at Mountain Pass. Rare Earths concentrate is sold in 2018.

In 2019 MP Materials achieves run-rate production of larger than 30,000 metric tonnes of Rare Earths Oxides REOs in concentrate form, or about15 percent of the global market. In 2020 MP Materials is publicly listed on the New York Stock Exchange. Production climbs to more than 38,500 metric tonnes, an all-time high in the 60-year history of Mountain Pass. The company receives two Department of Defense contracts to restore the USA domestic Rare Earths supply chain.

In 2022 commissioning for separations facilities at Mountain Pass was started. MP Materials breaks ground on a downstream magnetics facility in Fort Worth, Texas. MP Materials signs a long-term agreement with the General Motors Company to supply NdPr metal and NdFeB alloy and magnets for Electrical Vehicles EVs manufacturing.

In 2023 MP Materials started producing separated NdPr, cerium, and lanthanum products at Mountain Pass; MP Materials completes exterior construction of Fort Worth magnetics factory and begins trial commercial production of NdPr metal.

The MP Materials company achieved a record production of 11,478 metric tonnes of Rare Earths Oxides (REOs) in concentrate form during the fourth quarter Q4 2024, despite a planned maintenance shutdown. This represented a 24 percent increase from 9,257 metric tonnes produced in Q4 2023.

The rock at Mountain Pass contains an average of 7 to 8 percent Rare Earths elements, which is a remarkably high concentration by industry standards.

Discovered in 1949 while prospectors searched for Uranium, the Mountain Pass deposit instead revealed Bastnaesite, an ore rich in Rare Earths elements like Neodymium Nd, Europium Eu, and Dysprosium Dy.

Due to the geological advantages of the site, which averages around 6 percent Rare Earths content relative to 1 – 4 percent for most global deposits, MP Materials enjoys a global leading cost position.

Mountain Pass is a zero-discharge facility equipped with state-of-the-art environmental systems, including a dry tailings facility that recovers and recycles enough water to meet approximately 95 percent of need in the beneficiation and tailings management process.

The following processes are undertaken:

1. Mining: Bastnaesite ore is recovered from an open-pit surface mine and separated from the overburden waste.
2. Beneficiation: Through a process of crushing, milling, conditioning, and flotation, Rare Earths elements are separated from waste to produce a mixed Rare Earth concentrate.

3. Separation: The mixed Rare Earth concentrate undergoes a complex solvent extraction chemical process to purify, recover, separate, and precipitate individual Rare Earths elements.
4. Finishing: Pure forms of Rare Earths oxides – primarily Lanthanum La, Cerium Ce, and NdPr oxide – are packaged and treated to meet specific customer specifications.

MP Materials received a $58.5 million award to advance its construction of America's first fully integrated Rare Earths magnet manufacturing facility. The Section 48C Advanced Energy Project tax credit allocation was issued by the IRS and Treasury following a competitive, oversubscribed process administered by the Department of Energy that evaluated the technical and commercial viability and environmental and community impact of approximately 250 projects. Neodymium-iron-boron (NdFeB) magnets are the world's most powerful and efficient permanent magnets.

MP Materials Corp has been awarded a $35 million contract through the USA Department of Defense (DoD) Industrial Base Analysis and Sustainment Program to support the construction of a commercial scale processing facility for Heavy Rare Earths Elements (HREEs) at Mountain Pass. In a separate contract awarded in December 2020, the DoD committed $9.6 million to MP Materials' Stage II optimization, a project to restore Light Rare Earth Elements LREEs processing capabilities to Mountain Pass.

The ability to process Heavy Rare Earths Elements HREEs alongside LREEs will enable MP Materials to extract and refine all Rare Earths required to manufacture high-performance permanent magnets. It will also enable the company to recycle all recoverable Rare Earths from end-of-life magnets and magnet production scrap, increasing the resiliency and environmental sustainability of the USA's domestic supply base.

MP Materials Corp., the parent company that controls the Mountain Pass mining and processing operations, sends some of its ore to China for processing. A Chinese company, Shenghe Resources Holding Co., owns approximately 7.7 percent of the stock of MP Materials.

**USA BEAR LODGE MINE, WYOMING**

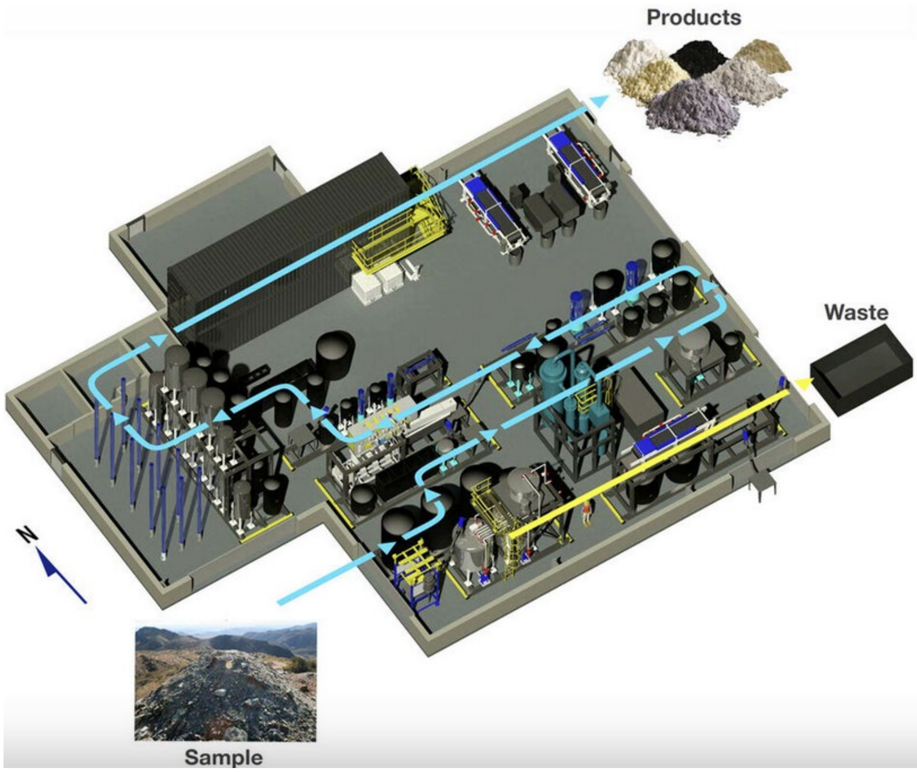


Figure 12. Layout of Rare Elements Resources' Rare Earths processing and separation demonstration plant.

The Bear Lodge Project is positioned to be a major North American source of Rare Earths Elements REEs. The quality and quantity of mineralization at Bear Lodge make it a world-class mining district and a dependable, long-term source for the REEs that modern technology demands.

The Project has a well-defined and drilled mineral asset, it is also one of the highest-grade deposits for the critical magnet REEs Neodymium, Nd and Praseodymium Pr as well as Samarium Sm and Terbium Tb.

The project is rich in the REEs critical to high-strength permanent magnet manufacturing and are higher-valued and expected to experience faster demand growth and better price support over the long term. It is situated in one of the best mining districts in the world. The mine site is ideally located in Northeastern Wyoming, just off Highway I-90, and has easy access to power and supporting infrastructure. The processing facility will be located nearby, in the town of Upton, Wyoming, in an established industrial area.

**HICK'S DOME, ILLINOIS, USA**

Hicks Dome is a structural dome which has its central Devonian magma core displaced upward some 4,000 feet or 1,200 m in relation to the surrounding strata. The dome has small associated igneous dikes around its flanks.

Hicks Dome is surrounded by the world-renowned Illinois-Kentucky Fluorspar District (IKFD), which produced over 90 percent of the nation's fluorspar until the late 20th century.

Hicks Dome is unique compared to other critical mineral prospects in the United States such as Mountain Pass in California and Bear Lodge in that it is anomalously one order of magnitude more enriched in the scarcer more desirable heavy Rare Earths Elements relative to the light ones. Hicks Dome is likely to possess one of the largest fluorspar reserves in North America.

The Illinois State Geological Survey ISGS estimates that there are 12 - 65 million raw tons of critical minerals ore within various deposits at the site. Hicks Dome is particularly enriched in the Rare Earths elements Dysprosium Dy, Scandium Sc and Yttrium Y.

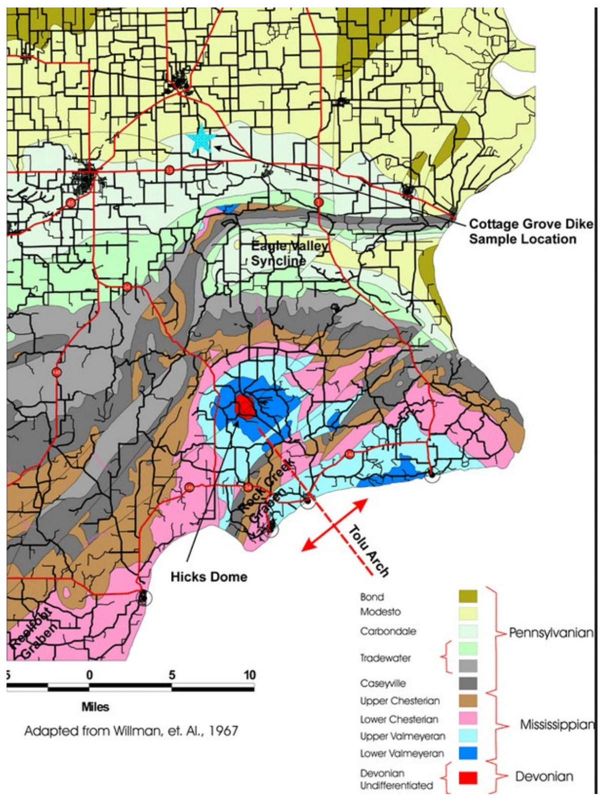


Figure 13. Hick's Dome, Illinois.

**BLACK SANDS, MONAZITE, EGYPT, SAUDI ARABIA**

Black sands often contain valuables elements, other than precious metals: Rare Earths elements, Thorium, Titanium, Tungsten, Zirconium and others are often fractionated during igneous processes into a common mineral-suite that becomes black sands after weathering and erosion.

World rivers sweep Monazite and Ilmenite ore minerals to sea beaches forming black sand dunes. Named after its color, black sand contains the minerals Ilmenite, Zircon, Magnetite, Rutile, Garnet, as well as Monazite, which contains Rare Earths elements and nuclear material ores of Uranium and Thorium.

Ilmenite is a Titanium-Iron oxide mineral with the idealized formula FeTiO. It is a weakly magnetic black or steel-gray solid. Magnetic separation is used to isolate these concentrates. Ilmenite is the most important ore of Titanium and the main source of Titanium dioxide,

Figure 14. Black sands sample contains the Monazite ore.

Monazite is a primarily reddish-brown phosphate mineral that contains Rare Earths elements as well as Thorium:

(Ce, La, Nd, Th)$PO_4$,
(La, Ce, Nd)$PO_4$,
(Nd, La, Ce)$PO_4$,
(Sm, Gd, Ce, Th)$PO_4$,
(Pr, Ce, Nd, Th)$PO_4$.


Figure 15. Monazite ore, St. Gotthard, Switzerland.

In Egypt, as a sediment deposited by the Nile River along the Mediterranean Sea shore, black sand is available on the coast overlooking the Mediterranean Sea from Rosetta (Rasheed) to Rafah along a length of 400 km.

The Egyptian Black Sand Company was established in 2016 in view of exploiting the resource. A black sand magnetic separation plant in El-Burullus was started in 2018 on an area of 80 acres in Kafr El-Sheikh, with an investment exceeding LE 1 billion. An Australian Egyptian company operates a magnetic separation plant in East El-Burullus and the other is a Chinese plant in the north of El-Burullus. The magnetic process separates Ilmenite as a source of Titanium. No attempt at separating the Rare Earths is reported. The radioactive content of the ores in Thorium and its decay products is undocumented as to its health effects on the mining work force and the local population.

Figure 16. Black sands monazite dunes, Egypt.

According to an aerial survey carried out by the Nuclear Materials Authority, Egypt has 11 sites of black sand along is northern coast. The reserves of those sands on the Egyptian coast reach about 1.3 billion cubic meters, including the Rosetta area, with reserves of 600 million cubic meters, Damietta area with a reserve of 300 million cubic meters, and El Arish and Rafah area in the Northern Sinai with 200 million cubic meters.

Mineral reserves in Egyptian black sands are estimated at 285 million tons, containing an average content of 3.4 percent of heavy metals along a span of about 22 km in the western sector which lies east of El-Burullus. There are also proven mineral reserves in the eastern sector of about 48 million tons containing an average content of 2.1 percent of heavy metals. The black sand in these areas contains eight types of heavy metals, ranging in composition between 1 percent and 8 percent.

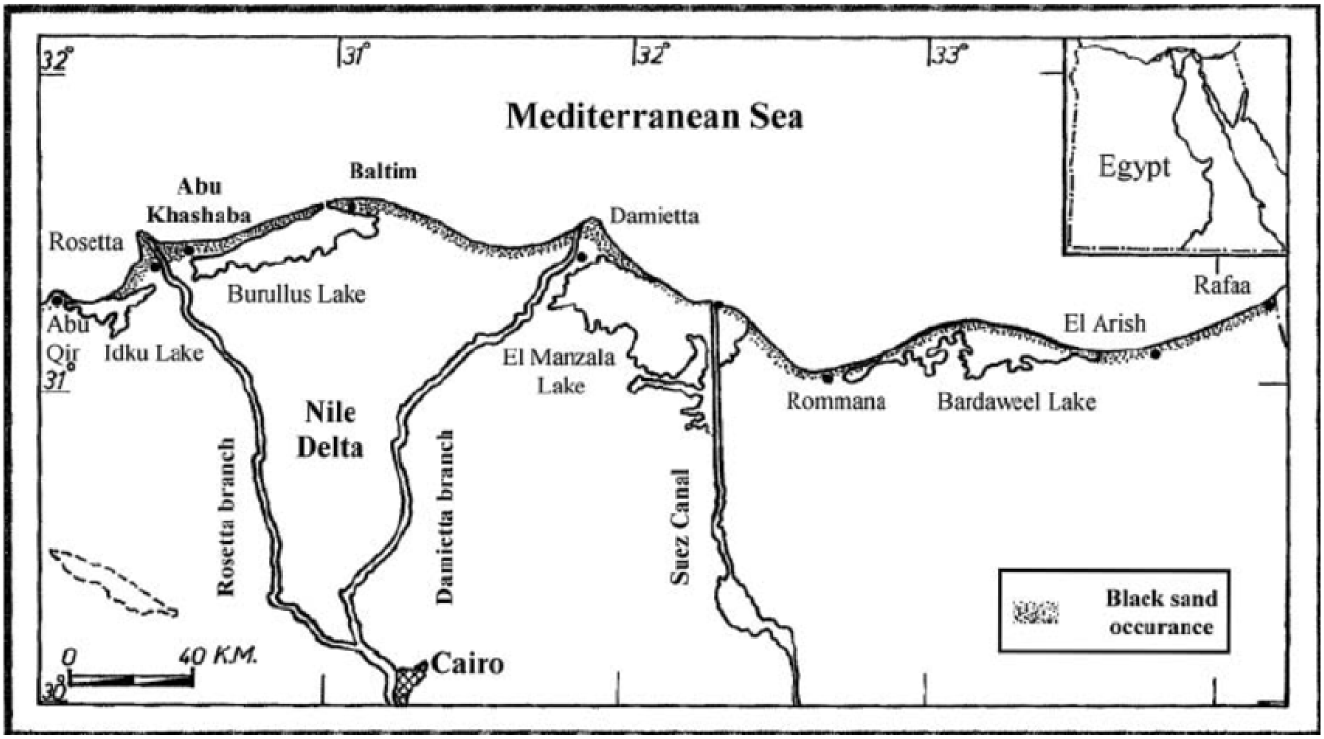


Figure 17. Black sands monazite locations at Baltim and Abou Khashaba, Egypt.

Rosetta has the largest reserves of black sand, with 500 million cubic meters, pointing out that the Egyptian sand deposits represent the largest reserves in the world, as they spread along areas on the Mediterranean coast. Egypt and Saudi Arabia are major countries with black sands resources.

Two magnetic separation units with an annual output capacity of 31,000 tons separate the magnetic elements. Apparently, no attempt is made at separating the REEs.

## RARE EARTHS ASSOCIATION WITH COAL [2]

Deposits of designated critical minerals needed to transition the world's energy systems away from fossil fuels may be co-located with coal deposits that have been mined to produce the coal as the fossil fuel most implicated in climatic change.

Research at the University of Utah documented elevated concentrations of a key subset of critical minerals rare earth elements in active mines rimming the Uinta coal belt of Colorado and Utah. The work is published in the journal Frontiers in Earth Science.

These mines could see a secondary resource stream in the form of metals used in renewable energy and numerous other high-tech applications. It is found that the rare earth elements are concentrated in fine-grain shale units, the muddy shales that are above and below the coal seams.

The association between coal and REEs deposits has been well documented elsewhere, but little data had been previously gathered or analyzed in Utah and Colorado's coal fields.

Researchers analyzed 3,500 samples from 10 mines, four mine waste piles, seven stratigraphically complete cores, and even some coal ash piles near power plants. The coal itself is not enriched in rare earth elements. A mining company mining a coal seam could take a couple feet off the floor at the same time or they could take a couple feet off the ceiling to extract the REEs. The highest prevalence of such concentrations is in coal-adjacent formations of siltstone and shale, while sandstone and the coal itself were mostly devoid of Rare Earths.

## LYNAS CORPORATION MOUNT WELD ORE PROCESSING FACILITY IN TEXAS

The USA Department of Defense DOD funded companies in allied countries, notably Lynas Rare Earths of Perth, Australia and Vacuumschmelze A.G. of Hanau, Germany, to begin building rare-earth and related facilities in the USA. Neo Performance Materials, based in Canada, already operates rare-earth processing facilities.

Lynas USA LLC is a wholly owned subsidiary of Lynas Rare Earths Ltd, an Australian company listed on the Australian Securities Exchange. Lynas was a significant producer of separated Rare Earth materials outside of China.

Lynas is building a new Rare Earths processing facility in Seadrift, Texas, to develop a domestic supply of Rare Earths for USA commercial and defense manufacturers.

The Seadrift processing facility is not a mine. In Australia, Lynas operates the Mount Weld Rare Earths mine, one of the world's highest-grade Rare Earths deposits. Lynas also used to operate an advanced Rare Earths processing facility in Malaysia that was shut down due to environmental public protests about the disposal of radioactive tailings from the plant. It operates a new Rare Earths processing facility in Kalgoorlie, Western Australia.

Lynas is building a Rare Earths processing facility in Texas to supply the USA defense industrial base and commercial manufacturers. The Texas facility will process mixed Rare Earths sourced from the Mount Weld Lynas mine in Western Australia and pre-processed prior to shipping to the USA. At the Texas facility, the imported mixed Rare Earths will be separated into individual elements to produce highly sought-after Rare Earths materials for manufacturing supply chains.

The facility is located on a 149-acre industrial site in Seadrift, Texas. The site was purchased from Union Carbide Corporation, a wholly owned subsidiary of Dow Chemical Company, and is located in an existing industrial zone.

The USA Government has awarded funds to Lynas USA LLC through the USA Department of Defense (DoD) to construct and operate a processing facility to produce Heavy Rare Earths HREEs and Light Rare Earths LREEs products. Lynas is targeting construction to begin in 2024 and the facility to become operational between July 2025 and June 2026 (Fiscal Year 2026). Lynas' USA Rare Earths processing facility will take a mixed Rare Earths blend and separate it into individual elements. The mixed Rare Earths blend will be pre-processed by Lynas prior to shipping to the USA and is presented as not a radioactive material.

Figure 18. Mount Weld mine, Western Australia.

The Texas plant has been designed with the ability to process third-party material. As third-party rare earths projects come online, Lynas will work to identify and qualify suitable Rare Earths inputs.

Lynas USA LLC has signed a follow-on contract with the United States USA Department of Defense (DoD) for the construction of the Heavy Rare Earths component of the Lynas USA Rare Earths Processing Facility in Texas.

The updated contract is an expenditure-based contract under which all of Lynas' properly allocable construction costs will be reimbursed. A contribution by the USA Government of approximately US$258 million is currently allocated to the Project. This is an increase from the approximately US$120 million announced in June 2022.

Once operational, feedstock for the Facility will be sourced from the Lynas Mount Weld rare earths deposit and Kalgoorlie Rare Earths Processing Facility in Western Australia. Mount Weld is recognized as a world-class source of Light and Heavy Rare Earths minerals. The USA Facility will be able to process feedstock from other sources if and when they become available and are qualified.

## OTHER OCCURRENCES OF RARE EARTHS ELEMENTS

Rare Earth Elements have also been identified in iron ores like in China, as well as Manganese nodules that can be mined at the bottom of the oceans and in still unexplored possible occurrences such as Round Top Hill, Texas, a possible volcanic magma intrusion.

Figure 19. Rare Earths have been identified in minable Manganese nodules, minable at the bottom of the oceans.

Figure 20. Round Top Hill possible volcanic magma intrusion, Texas, as a Rare Earths Elements occurrence.

## REFINING RARE EARTHS, SOLVENT EXTRACTION

### BENEFICIATION, FROTH FLOTATION

Refining rare earth ore into rare earth oxides begins with a process called beneficiation in the industry. Here, the rocks are first broken down into chunks of gravel that are then mixed with water and crushed into a slurry. Then, in the relatively environmentally friendly process used at Mountain Pass, called froth flotation, a kind of chemical reagent called a surfactant is added to the slurry. This mixture is introduced into a series of vessels, or cells, in which the surfactants cause the rare earth–bearing grains to bind selectively to bubbles floating to the top of the cells. As the bubbles float upwards, they carry the rare earth–bearing grains with them, separating them from the waste grains. After multiple stages, what is left after drying is a fine powder called rare earth concentrate. The goal is for this concentrate to be at least 60 percent rare earth oxides by weight.

### LEACHING

The next step is called leaching. At Mountain Pass, the concentrate is roasted and then leached with hydrochloric acid to place the high-value rare earth elements into solution. Most of the cerium, a radioactive low-value rare earth, and thorium are removed in this stage.

### LIQUID-LIQUID SOLVENT EXTRACTION

The next stage is the most complicated and important. Here, the specific rare earth elements being sought, for example neodymium and praseodymium, are separated from the other rare earths. The standard technique is called solvent extraction, and it is not much different from the process invented 70 years ago by researchers at Argonne National Laboratory and Oak Ridge National Laboratory for the separation of uranium, thorium and lithium fuels in nuclear applications.

The method is called liquid-liquid solvent extraction because it uses two immiscible solvents, one water- and the other organic-based such as Tributyl Phosphate TBP. The rare earths are dissolved in one of the solvents, which is mixed vigorously with the other one in ion exchange columns. To separate out specific rare earths, the process uses an organic extractant and exploits subtle differences in the affinity of that extractant for different rare earth elements under particular process conditions.

There is a water-based, acidic solution containing the rare earths, which is called the aqueous phase. It is mixed with an oil-based, or organic, phase, consisting of that organic extractant and a diluent. Technicians adjust the process conditions, such as temperature and pressure, to allow the extractant to bind preferentially to the specific rare earth ions to be recovered, say neodymium. When the aqueous phase and the organic phase are mixed vigorously, those neodymium ions bind to the extractant, which pulls them into the organic phase. Because this oil-based phase is not miscible with the aqueous one, the neodymium ions are separated from the others. In practice, the vigorous combining occurs in vessels called mixers, and then the combined liquids are pushed into an adjacent container called a settler, where the two phases slowly separate, with the target rare earths accumulating in the organic phase and the less-desired rare earths being scrubbed back into the aqueous phase.

This mixing and settling happens over and over again. Each time the concentration of the desired rare earths is increased incrementally. After many iterations in a cascading process, the target rare earths are then typically transferred back to the aqueous phase. Then they are recovered by means of a precipitation technique.

Properly tuned, the liquid-liquid solvent-extraction process can be extremely effective, producing rare earth oxides with purity greater than 99.9 percent. But it has some substantial drawbacks. In the process, the organic phase is a phosphate-based compound, such as tributyl phosphate, and the aqueous phase is a strong acid, such as hydrochloric, nitric, or sulfuric acids. These solvents and reagents are used in large quantities, which can be recycled but must all be disposed of eventually.

## ONGOING RESEARCH

Research now is aimed at identifying better solvent extractants—for example, ones that enable less acidic processes or that chemically bind more selectively with the desired rare earths. A measure of the effectiveness of an extractant is separation factor, which indicates how much of the target rare earth element is pulled from solution relative to adjacent rare earths as they go through one round of mixer-settlers. For the conventional system today, the separation factors of adjacent rare earths vary between 1.1 and about 6. For comparison, separation factors for other chemical-industrial processes can exceed 100.

If one can double or triple the separation factor, then one could halve or reduce the number of mixer-settlers steps by up to two-thirds.," A USA government-led consortium called the Critical Materials Innovation Hub, is sponsoring research on the problem. If there was a panacea to reduce the costs, the capital costs, the land usage, the water usage, and improve the environmental soundness of the processing, it would be to come up with chemicals that are environmentally safe, and that would also do a better job of separating the rare earths from each other.

## DIGLYCOLAMIDES DGA-6 AS EXTRACTANTS FOR RARE EARTH PROCESSING

Researchers at Oak Ridge National Laboratory will operate and analyze a pilot line based on a new chemical-extraction method. It appears capable of reducing the solvents, water, and energy needed to extract rare earths by as much as 60 percent in comparison with the standard extraction process.

Research chemist Santa Jansone-Popova, at Oak Ridge National Laboratory, introduced the DGA-6 chemical that could revolutionize rare earth extraction. With the conventional process, the solutions become more acidic as they proceed through successive stages of mixer-settlers. In order to recover those rare earth elements in that oil-aqueous separation system, you have to use more concentrated aqueous solution—more acidic solution. That, in turn, requires the use of alkali to lower the acidity of that solution, so that the aqueous stream can be recycled. That means adding more chemicals to the system, which is not ideal, and which, at the end, results in producing more waste, generating environmental concerns.

The solution is to use an extractant that does not operate based on adjustments in acidity. It operates by a different mechanism, adjustments in ionic strength. That means we can start with a more concentrated acid solution, and then we can recycle that acid solution without adding any chemicals. And when we want to recover those rare earth elements, we are using a very dilute acidic solution that, too, can be recycled after the precipitation of the rare earths. We can basically recover those rare earth elements with water. There are no additional chemicals added to the system, and all the acid that we are using in the process can be recycled.

The new extractants are also far more selective, improving the separation factor by two to three times in comparison with the existing processes.

The new high-efficiency process for extracting specific rare earth elements was pioneered at Oak Ridge National Laboratory. The process depends on a chemical, diglycolamide-6 (DGA-6) which is now being manufactured by Marshallton Research Labs.

The new extractant is from a chemical family called diglycolamides, or DGAs. DGA-6 is used in the oil phase, and another new extractant is used in the aqueous phase.

This new class of DGAs is much cleaner in its operation because these extractants are neutral. They are not acids. So, they do not require big swings involving neutralization of large amounts of acid. They are more efficient.

Over the longer term, Western rare earth producers are going to need something extraordinary to bolster their efforts to compete with their Chinese counterparts—who are also pursuing diglycolamides as extractants for rare earth processing.

**DISCUSSION**

There is no shortage of sources of REEs globally. The difficulty is in the required high-technical expertise in separation and refining them.

A pamphlet produced in December 2024 by the NATO Energy Security Centre of Excellence, based in Lithuania erroneously claims that: "Ukraine emerges as a key potential supplier of rare earth metals such as titanium, lithium, beryllium, manganese, gallium, uranium." In fact, none of those minerals are Rare Earths.

Ukraine has a large resource in rich grain production farmland and highly educated manpower resources that challenged the Russian Army with innovations in Drones warfare technology in addition to 23 biological laboratories possibly involved in biological Gain of Function GOF research.

Ukraine has substantial amounts of iron ores, coal and natural gas, as well as Lithium. Also, Manganese and Chromium in the Kirvbas region. The largest steel mill in the world is in Mariupol, a city fallen under Russian control. Incidentally, 'Donbass' literally means 'DONetsk coal BASin'. The region was named after its coal deposits, the largest in the former USSR.

"Every time Zelenskyy comes to the United States, he walks away with $100 billion," President Donald Trump said in September 2024. "I think he is the greatest salesman on Earth. But we are stuck in that war unless I am president." President Volodymyr Zelensky is an accomplished salesman in the world. He is selling a cat in a bag to President Donald Trump and his associates. He is thought to also "has a bridge in Brooklyn for sale." "Clever people setting up the USA to be the bag holder over worthless earth."

In 2010, the USA claimed that it discovered $1 trillion worth of untapped mineral deposits in Afghanistan, particularly Lithium, justifying its long twenty-years stay there. Afghanistan was referred to as "The Saudi Arabia of Lithium." Nothing of the kind ever materialized. Experts inform us that it is primarily smoke-and-mirrors, and it is obvious transparent geopolitical wordplay.

The USA has ample supplies of REEs to be mined and refined and a surplus to be exported in condensate form for refining at other destinations. The Ukrainian people deserves to benefit from its resources once peace and security predominate in Europe. Ukraine will share its mineral bounty with the rest of the world as it is sharing its grain production capability. The USA will help achieve peaceful rebuilding and coexistence among its allies in Europe. The world deserves avoiding escalation into a World War III, and worse, a Nuclear Holocaust. It is common sense that if Ukraine had easily recoverable REEs minerals, they would be already in the exploitation state.

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