



RARE EARTH ELEMENTS TANZANIA

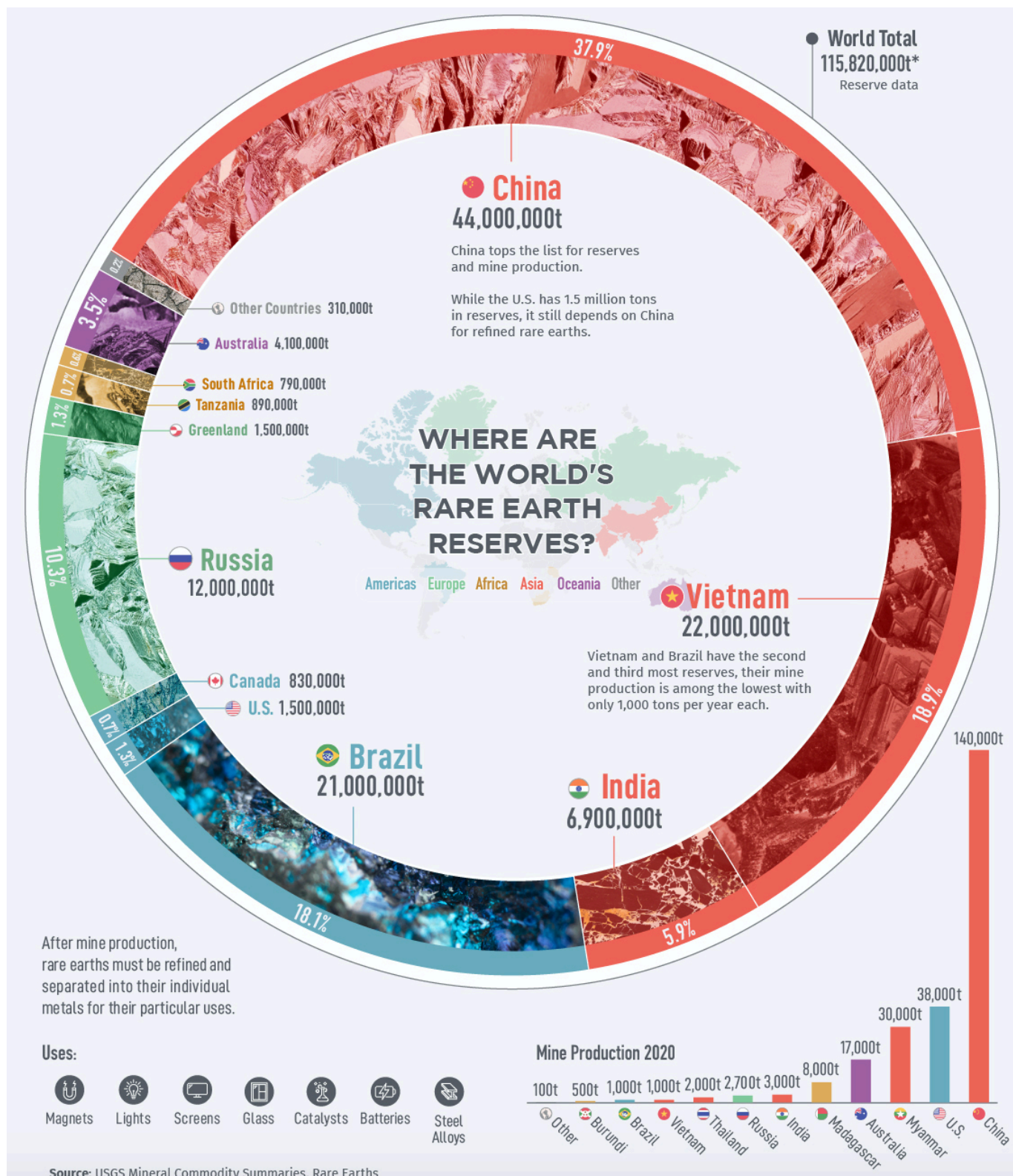


WHAT ARE RARE EARTH ELEMENTS

Rare earth elements are a group of metals that are critical ingredients for a greener economy, and the location of the reserves for mining are increasingly important and valuable.

The 17 rare earth elements are: lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu), scandium (Sc), and yttrium (Y).

GLOBAL RESERVES



APPLICATIONS

RARE EARTHS

GLASSES & POLISHING

Ce, La, Pr, Nd, Gd, Er, Ho
Polishing Compounds
Decolorizers/Colorizers
UV Resistant Glass
X-Ray Imaging

CATALYSTS

La, Ce (Pr, Nd)
Petroleum Refining
Catalytic Converter
Diesel Additives
Chemical Processing
Industrial Pollution
Scrubber

CERAMICS

La, Ce, Pr, Nd, Y
Eu, Gd, Lu, Dy
Capacitors
Sensors
Colorants
Scintillators
Refractories

OTHER

Nuclear (Eu, Gd, Ce, Y, Sm, Er)
Defense (Nd, Pr, Dy, Tb, Eu, Y, La, Lu, Sc, Sm)
Water Treatment
Pigments Ce, Y
Fertilizers

METALLURGICAL ALLOYS

La, Ce, Pr, Nd, Y
NimH Batteries
Fuel Cells
Steel
Lighter Flints
Super Alloys
Aluminium /Magnesium

MAGNETS

Nd, Pr (Tb, Dy)
Motors
Disc Drives
MRI
Power Generation
Micro Generation
Microphones & Speakers
Magnetic Refrigeration

PHOSPHORS

Eu, Y, Tb, Nd, Er, Gd (Ce, Pr)
Display Phosphors CRT, LPD, LCD
Fluorescent Lighting
Medical Imaging
Lasers
Fiber Optics



End-use

% of 2019 Rare Earth Demand

Permanent Magnets

38%

Catalysts

23%

Glass Polishing Powder and Additives

13%

Metallurgy and Alloys

8%

Battery Alloys

9%

Ceramics, Pigments and Glazes

5%

Phosphors

3%

Other

4%



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GEOLOGY



Tanzania has a strong mining history, as both Africa's fourth-largest gold producer and a lucrative hub for precious materials such as diamond and tanzanite.

With the government hand-over, a new emphasis on mining has taken the driving seat, with the Ministry of Minerals reportedly turning its attention to boosting mining's contribution to the GDP. The new administration is also seeking to enact mining companies' right to mine, as well as Tanzania's right to benefit from its mineral wealth.

The principal concentrations of rare earth elements are associated with uncommon varieties of igneous rocks, namely alkaline rocks and carbonatites abundantly available in the African geography

PROJECT - NGUALLA

The Ngualla Project

Mine Size: 65.45 Sq. Kms

It is a world-class rare earth development located near the Ngwala Village and approximately 150km from the City of Mbeya in the Songwe Region and on the edge of the East African Rift Valley. The project entails the construction of a mine, mill, concentrator, community projects and associated infrastructure. This high-grade rare earth concentrate will be shipped to our planned rare earth refinery.

Location: Tanzania (~1,000km west of Dar es Salaam and ~150km from Mbeya)

Geology: Weathered carbonatite with a high-grade bastnasite-rich zone, low in acid consuming elements and radionuclides

Ore Reserves: 18.5Mt grading 4.80% REO for 887kt REO

Mineral Resources: 214.4Mt grading 2.15% REO for 4.61Mt REO Resources

Life of Mine: +20 years (covering only Ore Reserves)

Mining: Open Pit with low strip ratio of 1.77

CATEGORY	ORE TONNES (MT)	REO%	CONTAINED REO (TONNES)
Proved	17.0	4.78	813,000
Probable	1.5	5.10	74,000
Total	18.5	4.80	887,000

NGUALLA PROJECT RESERVE ESTIMATE

PROJECT - WIGU HILLS

The Wigu Hill Project

Mine Size: 25 Sq. Kms

The deposit is located approximately 170 km south west of Dar es Salaam, Tanzania. It is a light rare earth element deposit and consists of a large carbonite complex with bastnaesite mineralisation with a NI 43-101 Inferred resource estimate of 3.3Mt at 2.6% LREO5 including 510,000t @ 4.4% LREO5 on 2 of 10 possible drill targets. Mineralisation is widespread over the entire hill with only two out of ten known targets drilled.

Location: Tanzania (170 km southwest of Dar es Salaam)

Geology: Large carbonite complex with bastnaesite mineralisation

Ore Reserves: 18.5Mt grading 4.80% REO for 887kt REO

Mineral Resources: 3.3Mt grading 2.6% REO

Life of Mine: +18 years (covering only Ore Reserves)

Mining: Open Pit with low strip ratio

ZONE	MT	TREO (%)	LA2O3 %	CEO2 %	PR6O11 (%)	ND2O3 (%)
Twiga NE	1.6	2.6%	0.98%	1.26%	0.1%	0.23%
Twiga SW	0.5	3.6%	1.33%	1.71%	0.13%	0.3%
Tembo NW	0.9	2.2%	0.78%	1.09%	0.09%	0.23%
Tembo SE	0.2	2.2%	0.69%	1.1%	0.1%	0.27%
Total Inferred Resource	3.3	2.6%	0.96%	1.27%	0.1%	0.24%

WIGU HILLS PROJECT RESERVE ESTIMATE

RARE EARTH METALS

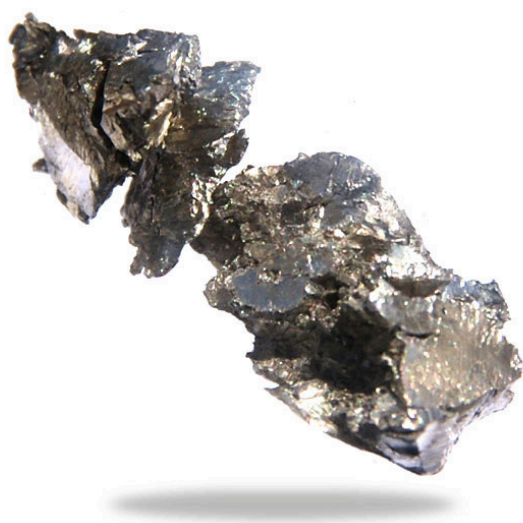
Neodymium (Nd)

Neodymium is a chemical element with the symbol Nd and atomic number 60. It is the fourth member of the lanthanide series and is traditionally considered to be one of the rare-earth metals. It is a hard, slightly malleable, silvery metal that quickly tarnishes in air and moisture. When oxidized, neodymium reacts quickly to produce pink, purple/blue and yellow compounds in the +2, +3 and +4 oxidation states



Praseodymium (Pr)

Praseodymium is a chemical element with the symbol Pr and the atomic number 59. It is the third member of the lanthanide series and is traditionally considered to be one of the rare-earth metals. It is a soft, silvery, malleable and ductile metal, valued for its magnetic, electrical, chemical, and optical properties. It is too reactive to be found in native form, and pure praseodymium metal slowly develops a green oxide coating when exposed to air.



FLOW CHART - MINE TO CONCENTRATE



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PROCESS AND END USE



Neodymium (Nd)

Neodymium magnets are manufactured by melting the mixture, consisting of neodymium, iron and boron followed by casting into ingots. The ingots are subsequently pulverized to powder, which, in turn, is sintered and magnetized to form the permanent magnet. An alternative approach is the controlled addition of boron to the neodymium iron master alloy to fabricate the magnet.

USES

Neodymium is used with iron and boron to create powerful permanent magnets used in computers, cell phones, medical equipment, toys, motors, wind turbines and audio systems.

Neodymium is used as a crystal (neodymium-doped yttrium aluminum garnet) in lasers to treat skin cancers and for laser hair removal

Neodymium is used to make specialized goggles for glass blowers.

Neodymium salts are used to color glasses and enamels.

Neodymium oxide and nitrate are used as catalysts in polymerisation reactions

PROCESS AND END USE



Praseodymium (Pr)

Praseodymium occurs along with other lanthanide elements in a variety of minerals. The two principal sources are monazite and bastnaesite. It is extracted from these minerals by ion exchange and solvent extraction.

Praseodymium metal is prepared by reducing anhydrous chloride with calcium.

USES

Carbon arc electrodes for studio lighting and projection.

Used in goggles used by welders and glassmakers

Used with Magnesium in Aircraft Engines

Used with Mischmetals to make flints for cigarette lighters

Used in high-intensity permanent magnets that are suitable for electric generators, motors of wind turbines and hybrid cars



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