

Critical Issues

Rare earth elements (REEs), also known as technology elements, are 17 metals that have many similar properties and occur together naturally in other countries.³ They are critical to the production of everyday technologies as well as that of strategic defense weapons important to the national security of the United States. All REEs are imported from other countries, making them important to international trade relations of the United States.

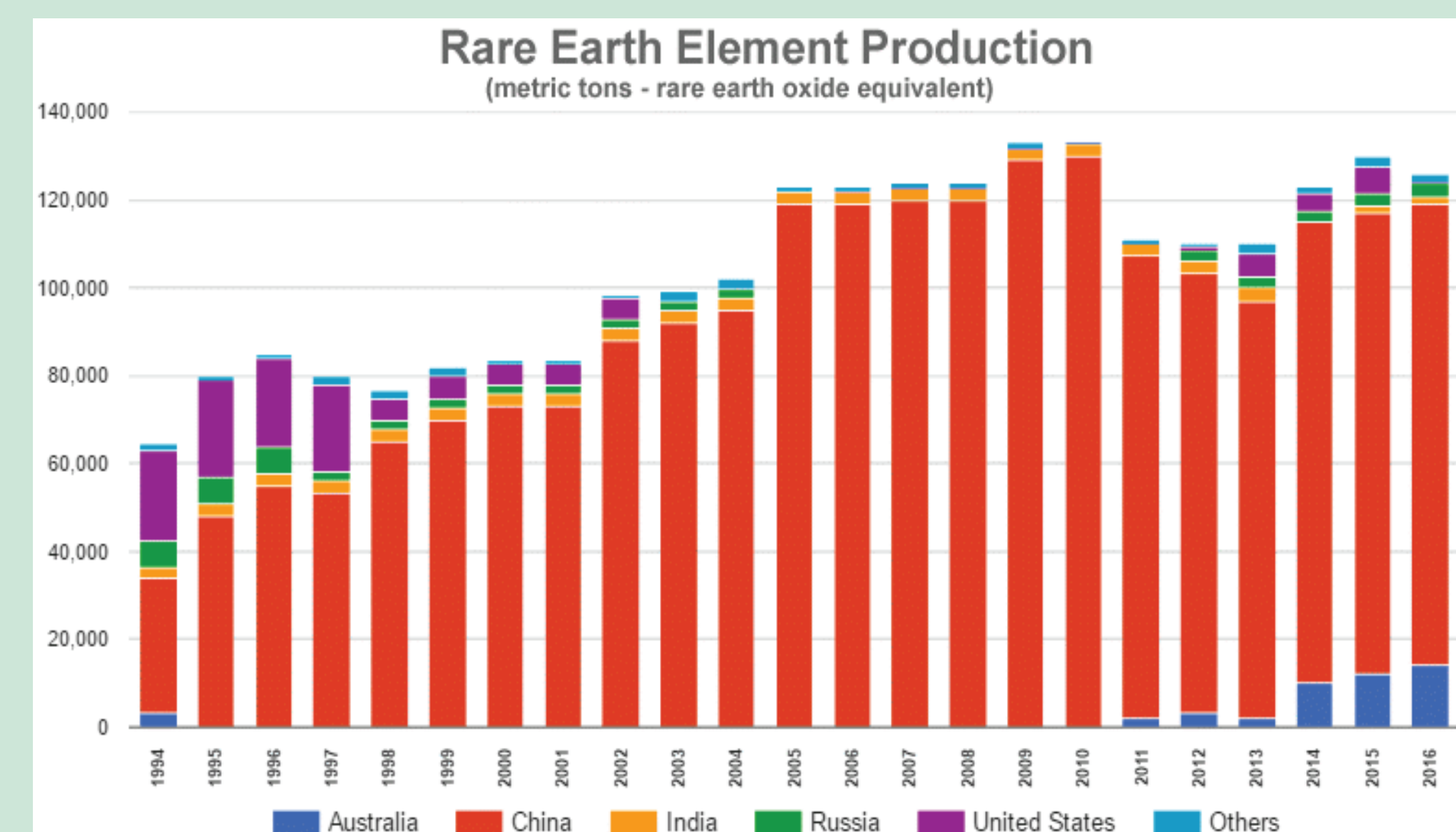


Fig 1: REE production chart: This chart shows China's dominance in the production of rare earth elements between 1994 and 2016.³

Most Americans have limited knowledge about REEs, let alone their critical contribution to technological advancements or the strategic need to maintain strong trade relations with China. It is important to note that 95% of all REEs are mined in China which significantly impacts our strategies for international affairs.³ The dangers of a single country controlling nearly all production of REEs includes the power to stop export and quickly cut off supply to the rest of the world. Alternative sources of supply take several years or longer to develop due to the rising and falling market prices of each commodity (REEs) and the start of a new production of supply.³

Important Uses in the United States

Tiny amounts of REEs are used in many devices that people use every day such as computers, rechargeable batteries, imaging and surgical lasers used in medical practices, cell phones and much more.³ As technology continues to advance in society, so will the demand for REEs. For example, several pounds of REEs are used in the production of each hybrid-electric and electric vehicle battery and the demand for these vehicles is expected to rapidly increase as the United States becomes increasingly energy independent of other countries.³

These metals also play an essential role in national defense, as they are used in the production of equipment and weapons that give the United States military an enormous advantage.³ Figures 7-10 show REEs used for defense, all of which are imported from China. If even some of these elements are withheld, it would undoubtedly affect all Americans.

Rare Earth Elements by Geology.com																	
H																	He
Li	Be																
Na	Mg																
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

Figure 5: REEs on the periodic table are the 15 lanthanide series elements, plus yttrium. Scandium is found in most REE deposits and is sometimes classified as a rare earth element.³



Fig 6: REE Samarium (seen in Fig. 8) used in precision-guided weapons.



Fig 2: Close-up of one mineral cabinet in the showcase displayed at the USGS-CRC.

Defense Uses of Rare Earth Elements	
Lanthanum	night-vision goggles
Neodymium	laser range-finders, guidance systems, communications
Europium	fluorescents and phosphors in lamps and monitors
Erbium	amplifiers in fiber-optic data transmission
Samarium	permanent magnets that are stable at high temperatures
Samarium	precision-guided weapons
Samarium	"white noise" production in stealth technology

Fig 3: Strategic defense uses of REEs.³



Fig 4: The Morenci mine, the largest Copper mine in North America.



Figure 7: Dysprosium
Dy- Atomic number 66.
Used in neutron absorption in nuclear reactors.

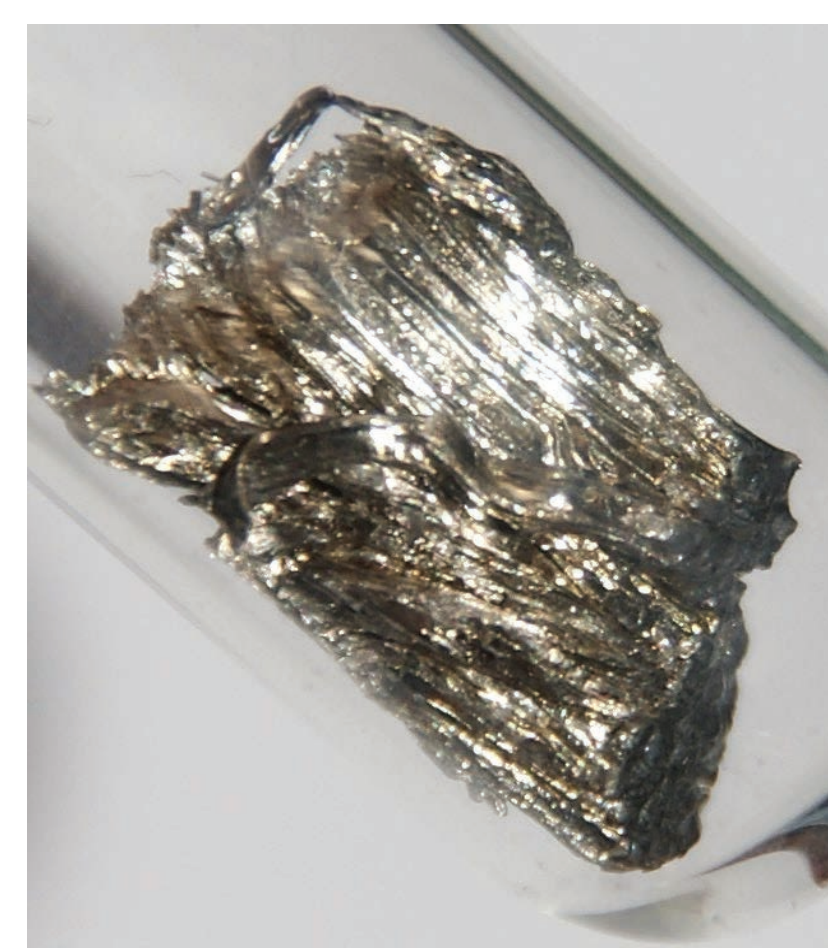


Figure 8: Samarium
Sm- Atomic number 62.
Used as magnets and in some cancer treatments.



Fig 11: Mineral showcase displayed at the USGS-CRC.

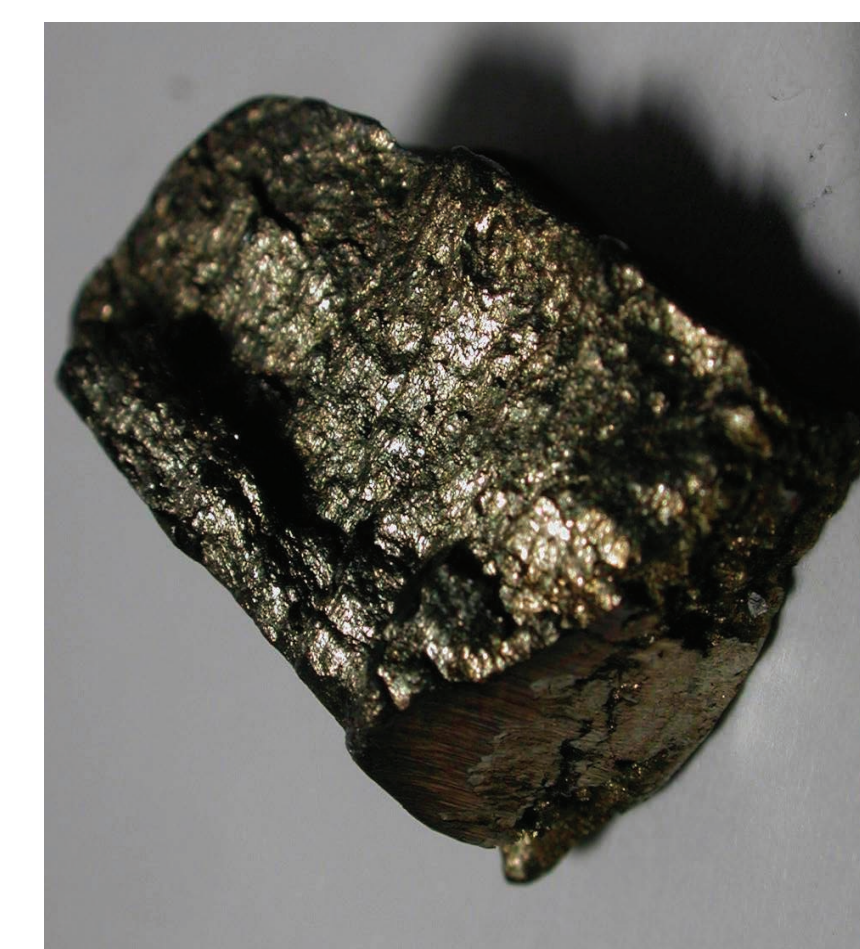


Figure 9: Praseodymium
Pr- Atomic number 59.
Used in super magnets and aircraft engines.



Figure 10: Neodymium
Nd- Atomic number 60.
Used in lasers and inferred wavelengths.

Mineral Showcase

While all REEs are imported, there are other elements mined within the United States that are used in every day society. As part of this project, a mineral display (Figures 2 and 11) was created to showcase prime examples of minerals mined in the United States. In creation of the display, Amye and Billy first documented and categorized the mineral collection by taking pictures and researching mineral information. They cut mirrors, drilled holes in the cabinets for lighting, and ordered parts for inside the display that best showcased the minerals. Plenty of research went into creating detailed labels for all the minerals, providing educational information for viewers such as the chemical formula, where they are mined, and what they are used for in manufacturing. This showcase is located at the United States Geological Survey Core Research Center (USGS-CRC).

What America is Doing Now

If China were to cut off import of REEs to America, it would threaten America's advancements in technology, national security, and would increase dependence on other countries. Therefore, there is an enormous need to stock pile these imports and come up with alternative plans in case of such an event.

America is in the process of building a stock pile of these stratelements in efforts to ensure our national security as well as reduce the cost of importing REEs into the United States.² In the meantime, methods are being sought out to reduce the use of REEs in products, seeking out alternative materials to replace REEs, and developing manufacturing products that do not use REEs.³

Acknowledgements



Fig 12: Billy and Amye by the completed mineral showcase



Fig 13: Amye, John Rhoades and Billy

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