CASE STUDY: RARE EARTH ELEMENTS (REES)

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Source: Shutterstock

'If you have a phone, a camera or an electric car, chances are that each of these devices is wholly dependent on key minerals that, at the moment, are processed only in China.'

Source: https://www.smh.com.au/world/asia/australia-s-race-against-china-s-rare-earths-weapon-20200825-p55p8s.html

Syllabus: Natural Resource Use

- the nature of natural resources
- spatial patterns and consequences of the distribution and consumption of natural resources at a global scale
- economic and political issues related to the use of natural resources, their ownership and management
- environmental and social issues related to the use of natural resources such as ecologically sustainable development, and the impacts on, and responses of, indigenous peoples

Nature of Rare Earth Elements (REE)

The rare earth elements (REE) are a unique group of 17 chemically similar elements - scandium, yttrium, and 15 lanthanides (cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, samarium, terbium, thorium, thulium, ytterbium).

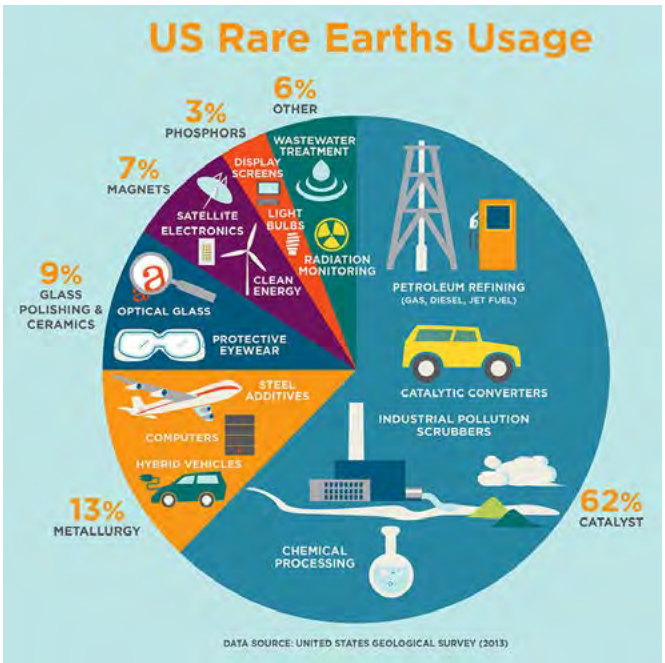
REE have many very specific uses, See Figure 1. The minerals from which REE's are extracted are difficult and costly to mine. Cheaper substitutes are considered inferior or no substitutes have yet been found.

Technological advances have increased the importance of REE in domestic, medical, industrial and strategic applications because of their unique properties. Uses of REE include the production of magnets, motors, electronic and computing equipment, batteries, petroleum, medical images, glass and ceramics (colouring agents) and lasers. In recent decades these uses have multiplied e.g. phone touchscreens and camera lenses, wind turbines, LED lights and electric cars. One electric car for example, uses 16kg of rare earths.

'As the world's appetite for technology increases, as we move towards electric vehicles and as every individual owns several handheld digital devices, the need for rare earths increases.'

Source: https://www.intheblack.com/articles/2019/08/01/extracting-truth-about-rare-earths

Figure 1: Rare Earth Usage in the USA



US Geological Survey. Source: https://www.jics.tennessee.edu/files/images/rare-earths-infographic-rev.jpg

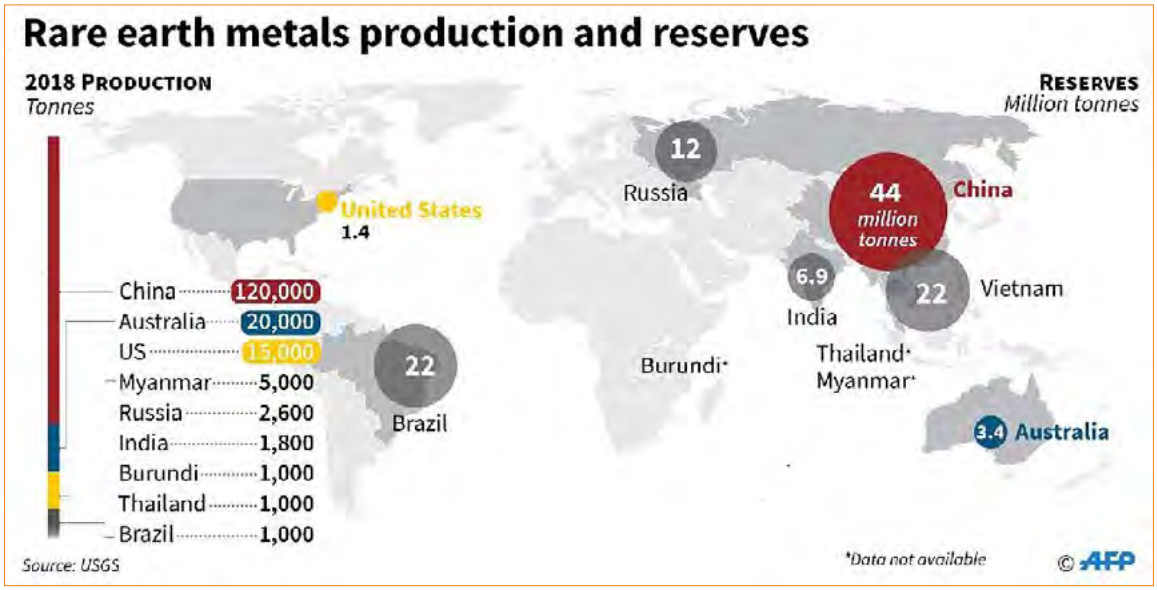
Spatial patterns, distribution and consumption

Rare earths are generally very abundant with global reserves greater than those of silver, similar to those of copper and lead and in the case of thulium and lutetium (two of the least abundant earths) 200 times more common than gold. See Figure 2

China's controls of 95 percent of the world's supply of rare earth metals but it is not the only country with large reserves. However, very little is produced elsewhere because of environmental and economic costs – mining creates large amounts of toxic waste and production costs are high. China's poorer environmental regulations and lower production costs have contributed to it becoming the world's leading producer.

The United States Geological Survey estimated that in 2018 there were 120 million tonnes of deposits worldwide including 44 million in China and 22 million in both Brazil and Vietnam. See Figure 2

Figure 2: Reserves of rare earth metals, by country and annual production in 2018.



Source: USGS https://scx2.b-cdn.net/gfx/news/2019/rareearthmet.jpg

Issues related to the use of natural resources, their ownership and management

Economic and political issues

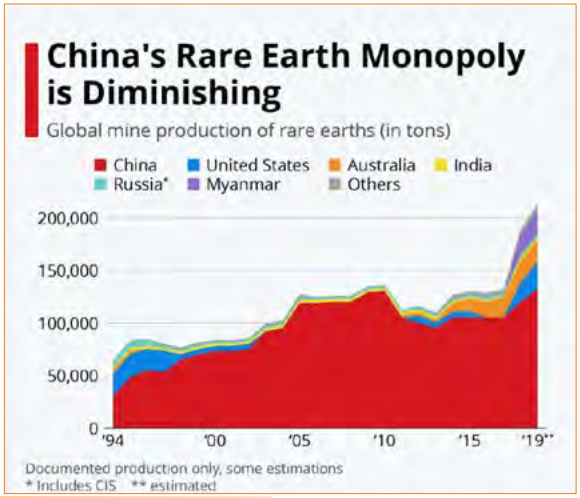
Rare Earths have been used as political instruments by China in disputes with other countries. When the USA banned the export to China of technology containing rare earths from China, the Chinese government threatened to stop supplying them. China also threatened to interrupt supplies of rare earths to other western markets. In 2010 supplies of REE to Japan were disrupted amid a dispute over the sovereignty of uninhabited islands. China also cut general export quotas in 2010 to preserve supplies for its own industry, forcing global prices to increase astronomically.

'In 2018, Beijing was accused of dumping products that undermine the security of US-based rare earth metal productions. In doing so, China undoubtedly lowered the price of materials, thereby undercutting producers in other countries and driving them out of business.'

https://www.futuredirections.org.au/publication/countering-chinas-grip-on-rare-earth-commodities/

Despite challenges created by actions of the Chinese government, production in other countries has grown since 2010, a trend predicted to increase and over time reduce China's monopoly. See Figure 3

Figure 3: Rare Earth production over time



Source: Statistica https://www.statista.com/chart/18278/global-rare-earth-production/

Ecological and social issues

Extracting rare earth elements from host rocks is chemically complex and expensive, requiring large quantities of energy, water and acid, often leaving radioactive waste.

Environmental problems are caused by the two main extraction methods

- Removing the topsoil, transporting it to a leaching pond, and adding chemicals to separate out the metals. These chemicals can create air and groundwater pollution and cause erosion.
- Drilling holes into the earth, inserting pipes and hoses, pumping in chemicals to flush out earth in a slurry that is pumped into ponds to separate out the REE. The chemicals used create similar problems to the topsoil removal process with the added impact of pipes and equipment littering the environment.

Chemicals continue to leach into groundwater and waterways from abandoned mines.

Rare earth elements often have a radioactive element — thorium in small concentrations that could affect the environment and the people – not enough ids known yet about this potential threat.

Villagers have lost their farming lands and are forced to work in contaminated, poorly regulated mines for low wages. The chemicals used cause health issues such as causing tooth and bone decay. Food production has been impacted by polluted soil and water.

> *"The results are jarring: In mineral-rich regions of China, poisoned water and soil have caused abnormal disease rates in "cancer villages" from which impoverished residents cannot afford to move. Crops and animals have died around a crusty lake of radioactive black sludge formed from mining waste near a major mining site in Baotou, Inner Mongolia. It's so large that it is visible by satellite."*
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> Source: https://www.latimes.com/world-nation/story/2019-07-28/china-rare-earth-tech-pollution-supply-chain-trade

The Future

The nature, production and consumption of REEs in the future will be influenced by several important processes

- Finding more sustainable options for extraction. Rare-earth metal extraction has the potential to be done without environmental harm. One method from Harvard University proposes using mild acidic solutions to separate metals from the earth.
- Finding alternatives to rare earths and developing products that rely less on rare-earth metals. Honda is reportedly developing hybrid cars that are mostly free of rare-earth metals.
- Using diplomacy to incentivise reform of China's lax environmental regulations and improve standards for environmental protection.
- Research and production for sustainable REE production at a global scale to reduce China's monopoly.

LEARN MORE ABOUT RARE EARTHS: MEDIA REPORTS

- Extracting the truth about rare earths (Includes a podcast) – https://www.intheblack.com/articles/2019/08/01/extracting-truth-about-rare-earths
- The hidden costs of China's rare-earth trade – https://www.latimes.com/world-nation/story/2019-07-28/china-rare-earth-tech-pollution-supply-chain-trade
- What are rare earth elements and why are they so important? – https://www.euronews.com/2019/08/15/what-are-rare-earth-elements-and-why-are-they-so-important-in-the-us-china-trade-war
- US-China trade war: China may use rare earth dominance to strike back – https://www.straitstimes.com/world/united-states/china-may-use-rare-earth-dominance-to-strike-back (Includes an infographic)
- Global Times: Ensuring rare-earth dominance crucial in trade war – https://www.globaltimes.cn/content/1171149.shtml
- China Wrestles with the Toxic Aftermath of Rare Earth Mining – https://e360.yale.edu/features/china-wrestles-with-the-toxic-aftermath-of-rare-earth-mining
- Boom in Mining Rare Earths Poses Mounting Toxic Risks – https://e360.yale.edu/features/boom_in_mining_rare_earths_poses_mounting_toxic_risks
- How Rare-Earth Mining Has Devastated China's Environment – https://earth.org/rare-earth-mining-has-devastated-chinas-environment/
- Countering China's Grip on Rare Earth Commodities – https://www.futuredirections.org.au/publication/countering-chinas-grip-on-rare-earth-commodities/
- The story of rare earth elements (REEs): occurrences, global distribution, genesis, geology, mineralogy and global production – https://www.researchgate.net/publication/340468310_The_story_of_rare_earth_elements_REEs_occurrences_global_distribution_genesis_geology_mineralogy_and_global_production
- Rare Earths: Outlook to 2030 – https://roskill.com/market-report/rare-earths/