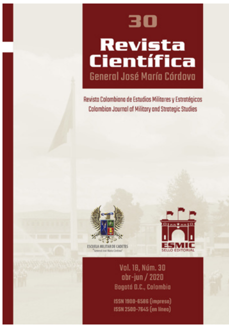

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Geopolitics of rare earths: a strategic natural resource for the multidimensional security of the State

Carlos Enrique Álvarez Calderón
https://orcid.org/0000-0003-2401-2789
carlos.alvarez@esdegue.edu.co
Escuela Superior de Guerra "General Rafael Reyes Prieto", Bogotá D.C., Colombia

John Heberaldo Trujillo Palacio
https://orcid.org/0000-0002-1874-4695
john.trujillopa@buzonejercito.mil.co
Escuela Superior de Guerra "General Rafael Reyes Prieto", Bogotá D.C., Colombia

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Geopolitics of rare earths: a strategic natural resource for the multidimensional security of the State

Geopolítica de las tierras raras: un recurso natural estratégico para la seguridad multidimensional del Estado

Carlos Enrique Álvarez Calderón y John Heberaldo Trujillo Palacio
Escuela Superior de Guerra "General Rafael Reyes Prieto", Bogotá D.C., Colombia

Abstract. The rare earth group includes 15 lanthanides along with yttrium and scandium. Although they are not that rare, they are found in different types of deposits and very distinctive places. Because of their exceptional magnetic and conductive properties, they have become increasingly important for both the technology and the military sectors; this makes them a strategic natural resource of geopolitical relevance, which can affect the multidimensional security of states. This article examines the history of the discovery and use of these elements, the strategic factors in their extraction and processing process, and China's dominant geopolitical position in the sector, as well as their illegal exploitation in Colombia and their importance in security studies.

Keywords: geopolitics; illegal mining; multidimensional security; organized crime; rare earth elements

Resumen. El grupo de las tierras raras incluye los 15 lantánidos junto con el itrio y el escandio. Aunque no son tan raros, se encuentran en distintos tipos de depósitos y en lugares muy específicos. Por sus excepcionales propiedades magnéticas y conductoras, para las tecnologías y el sector militar son cada vez más importantes. Esto los convierte en un recurso natural estratégico de relevancia geopolítica, que puede afectar la seguridad multidimensional de los Estados. Este artículo analiza, desde la historia del descubrimiento y el uso de estos elementos, cuáles son los factores estratégicos en el proceso de extracción y procesamiento, la posición geopolítica dominante de China en el sector, así como la explotación ilegal en Colombia. Así, este artículo muestra la importancia del tema en los estudios sobre seguridad.

Palabras clave: crimen organizado; elementos de tierras raras; geopolítica; minería ilegal; seguridad multidimensional

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Contact: Carlos Enrique Álvarez Calderón carlos.alvarez@esdegue.edu.co

Introduction

Located on the sixth row of the periodic table are the 15 lanthanides, which, together with yttrium (Y) and scandium (Sc)[1], are best known as "rare earth". Although they were so named because they were thought to be rarely found, they are not that rare on planet earth; these 17 chemically similar elements are abundant in the earth's crust. According to Klinger (2017), the issue is that not all rare earth elements are found in the same types of mineral deposits. Most of them are scattered in different locations and different concentrations, incidentally coinciding with heavy metals and hazardous elements that make their extraction challenging and expensive, such as uranium, thorium, arsenic, and fluoride." (Klinger, 2017, p. 1)

However, this has not hindered the "fever" of searching, exploiting, and processing these metals from becoming a matter of National Security for state actors dependent on the emergence of new technologies, given the metals' exceptional magnetic and conductive properties. Indeed, end products for rare earths range from consumer electronics to sophisticated weapon systems (Ting and Seaman, 2013), making these natural resources[2] strategic inputs that are mined to ensure the survival, welfare, and prosperity of various states, regardless of their level of technological and industrial development.

Although they are often addressed and studied as a group, rare earth elements have individual qualities that place them in specific markets and uses. Together, "these elements allow both the *hardware* and *software* of contemporary life to be lighter, faster, stronger, and more potent". (Klinger, 2017, p. 1) From aircraft engines to oil and natural gas drill bits, from lighting and optics to electronic displays on mobile phones, from permanent magnets to smart missile guidance systems, rare earth elements are needed for many technological applications in today's world. However, each of these uses requires a different element or combination of elements. In addition to the previous is their importance for emerging and potentially disruptive technologies, such as the new electric vehicles that will gradually replace traditional fossil fuel-based vehicles. In this sense, the high demand for rare earths (for both military and civilian industries) will increasingly influence geopolitical dynamics in the coming years, as the world accelerates its energy transition and modes of transport evolve.

This research article analyzes the potential global geopolitical "storm" scenario that could come about with the increased demand for rare earths by private and state

1 Although rare earth elements are made up of 15 chemical elements on the periodic table, scandium and yttrium have similar properties with mineral assemblies; thus, the specialized literature on the subject also refers to them as rare earths.

2 As Álvarez et al. (2017) claim, a natural resource is any physical good or service from nature that satisfies human needs

actors. Beyond their importance as strategic natural resources[3], constituted as elements of political, economic, and military synergy, their considered value may increase to the extent that scarcity and lack of available substitutes for such rare earths give rise to new security risks and vulnerabilities that may affect the vital interests of states (Álvarez, Ramírez et al., 2018). In other words, this article addresses rare earths as a strategic natural resource where lack of access to them could constitute a multidimensional security risk, with the potential to escalate into an active security threat.

Security studies are a research agenda within the field of international relations and the discipline of Political Science (Álvarez, Corredor et al., 2018). Since the end of the Cold War, the concept of *security* has been the subject of an academic debate in which security scholars have been divided mainly into two camps, the revisionists and the traditionalists (Dalby, 1997; Booth, 2005; Browning & McDonald, 2013). Through critical studies on the subject, the revisionists seek to expand the analytical and conceptual framework of security beyond the state and conventional national interests related to military defense (Buzan et al., 1998; Williams, 2003). These studies are explicitly focused on the political implications of security in an attempt to review the actions marked by the extraordinary use of the military. Thus, at the ontological and epistemological core of this perspective, security studies entail a political claim in favor of the appropriate use of power by the appropriate authorities to guarantee peace, freedoms, and human prosperity (McSweeney, 1999; Weldes, 1999; Dillon, 2002; Booth, 2005). In turn, traditionalists prefer to limit the conceptual and analytical scope of security to nation-states in order to maintain parsimony for theory-building (Walt, 1991; Lipschutz, 1995; Dannreuther, 2014).

It is evident that both fields have very different ontological, epistemological, and methodological views on the purpose of the analysis and understanding of security. Critical security studies are mainly concerned with identifying the possibilities and barriers to human emancipation. Meanwhile, traditionalists give priority to explaining the causes of war between a discrete set of nation-states labeled, "great powers." This article's contribution may better suit the broader field of this debate, given that there are inherent political motives in actions that invoke security for the purpose of claiming control over the provision of rare earths. These political motives are underpinned by the implications that these elements have on the economy, environment, humanity, and national security.

The premise that security must be addressed from multiple dimensions does not imply that there is no overlap or connection between the various categories of security,

3 According to Álvarez et al. (2017), a strategic natural resource is any low or high-value natural resource that is vital to the security, development, and prosperity of a state and its society.

more so, when the control of the supply of rare earth is presented as a multifaceted political issue. This article examines how specific actors, events, and institutions generate rare land geopolitics and how, in remote locations, rare land elements are sometimes a mere pretext for broader geopolitical and geoeconomic conflicts. Therefore, two questions guide this article. What are rare earths, and how did they become so important for the states' multidimensional security and why, given their relative ubiquity in the earth's crust and their overwhelming importance in everyday life, is the geography of its extraction restricted to so few places?

Rare earths, neither rare nor earth

For starters, rare earths are not entirely "rare." They were given this name because they were unfamiliar when they were initially discovered, hence, considered rare elements (Klinger, 2017). Most rare earths were discovered in the 19th century, with the exception of yttrium (1794), lutetium (1907), and promethium (1943). Yttrium (Y) was discovered in 1794 by the Finnish mineralogist and chemist Johan Gadolin in a mineral. This dark rock also contains cerium, lanthanum, and iron; it was later named *gadolinite* in Gadolin's honor[4]. Until 1885, it was assumed that these types of metal were almost entirely confined to a few dispersed locations in Scandinavia and the Ural Mountains. Because they had not been found anywhere else, it was assumed that they were scarce elements, which is why they were given the name "rare earths" (Klinger, 2017). Remarkably, the term "rare" persists to this day, even though it relates more to their history in science than their true qualities. In 1860, during the First International Conference on Chemistry held in Karlsruhe (Germany), Dmitri Mendeleev, Julius Meyer, and other chemists that there was no room for most of the lanthanides. Currently, they are the 15 elements ranging from lanthanum to lutetium with atomic numbers 57 and 71, respectively (Klinger, 2017). According to Scerri (2020), "Lanthanides would be a problem for all discoverers of the periodic system, as only 6 of the 14 lanthanides had been discovered before the 1860s, when these first periodic systems were under development" (p. 83). However, "Some of the elements known at that time (lanthanum, cerium, terbium, and erbium) suggested the presence of a rare earth family, which would be known as the lanthanide series" (Kinger, 2017, p. 41), located at the insular base of the periodic table.

4 Another natural element that is indirectly named after a person is samarium, from the mineral samarskite, in honor of the Russian mining engineer who discovered it, Vasili Samarsky-Bykhovets.

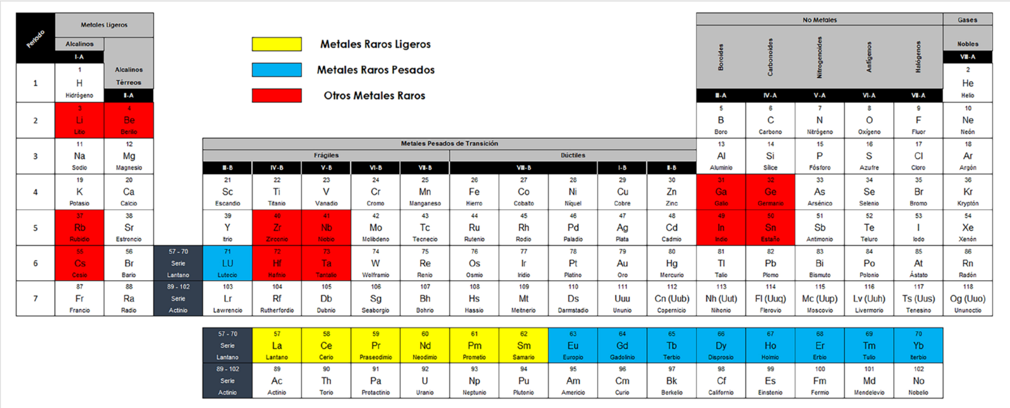

Figure 1. Periodic Table.
Source: Created by the author

The name "earth" also has a historical explanation. Most of the rare earth elements were first extracted as oxides. In French, an important scientific language in the 19th century, the oxide of an element was known as *terre*, that is, "earth." In German, equally important at that time, the rust of an element was called *erde* (earth). Therefore, metal oxides were called "earths." For example, magnesium was known as "bitter earths," zirconium as "zirconium earths," and beryllium as "beryllium earths." (Greinacher, 1981)

Thus, the term "rare earths" is inappropriate for a number of metals that are neither earths nor rare. That is, they are not alkaline earth elements, as the elements in group II-A of the periodic system of elements, including beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra). Rare earth elements, on the other hand, belong to the transition metals in group III-B. Although rare earth mineral deposits are highly restricted in number, the abundance of these elements is quite high. According to Voncken (2016), the most common rare earth element is cerium (Ce), with a cortical abundance of 60 parts per million (ppm). It is element 27 in the earth's crust, and it has a higher abundance than, for example, lead (Pb), element 37, which has a cortical abundance of 10 ppm. One of the least common rare earth elements, lutetium, has a crustal abundance of 0.5 ppm and has approximately 200 times the crustal abundance of gold (0.0031 ppm).

However, the elements that are grouped with the lanthanide series in the rare earth group have changed over time. For example, in the first half of the 20th century, thorium (Th) and uranium (U) were called rare earth elements because of "their chemical affiliation and frequent geological coincidence" (Klinger, 2017, p.42). Similarly, Klinger (2017) noted that scandium (Sc) and yttrium (Y) have, on occasion, been considered rare earth elements, even though they are found elsewhere in the periodic table (21 and 39, respectively). Klinger (2017) has also noted that nobium (Nb), mined mainly in Brazil, and Tantalum (Ta), one of the most notorious conflict minerals mined in the east of the Democratic Republic of Congo, are often grouped with rare earth elements. However, “despite their geological coincidence and similar ductile properties” Klinger, 2017, p. 42), they are not presently considered rare earth elements. In this order of ideas, the rare earth elements are a grouping of 17 different metals that are represented in the periodic table by the 15 elements of the lanthanide group, from lanthanum (A) to lutetium (L), yttrium (Y), and scandium (SC). (Figure 2). The rare earth group includes approximately 17% of all the natural elements; it is generally divided into two subgroups according to atomic weight, light rare earth elements (LREE) and heavy rare earth elements (HREE). The People’s Republic of China adds another subgroup, the medium rare earth elements (MREE).

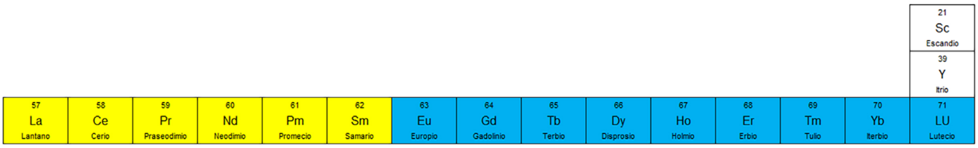

Figure 2. Rare Earths.
Source: Created by the author.

Although most rare earths are relatively abundant, they are dispersed throughout the earth’s crust, threaded through deposits of iron, phosphate, and copper-gold. According to Klinger (2107), “they are also found in residual deposits formed by the extensive erosion of igneous rocks, which explains why they appear on the black sand beaches of countries such as Brazil, India, and elsewhere” (p. 44). The first rare earth ore to be used was gadolinite, from which various of the rare earth elements were isolated for the first time, although they were not applied on an industrial scale. Currently, the main ores[5] of rare earth elements are monazite, bastnaesite, and xenotime, monazite being the first rare earth ore to be used industrially.

Rare earth production generally involves two phases, mining, and processing, which include various levels of processing required for different end uses. The main stages of extraction and processing of rare earth materials include (Kiggins, 2015):

1. Extraction of rare earth ore from mineral deposits;
2. Separation of the ore into individual rare earth oxides;
3. Refinement of rare earth oxides into metals with different levels of purity;

5 An ore of a chemical element, usually a metal, is a mineral from which that element can be extracted because it contains it in sufficient quantity to be used. Thus, a mineral is said to be the ore of a metal when, through a mining process, that mineral can be extracted from a deposit and then, through metallurgy, the metal can be obtained.

4. Alloying of rare earth metal, and
5. Transformation of rare earth alloys into components used in commercial and defense applications

Although used in relatively small quantities, their magnetic and conductive qualities are potentialized when combined with other elements such as iron or nickel. According to Ting and Seaman (2013), a convenient analogy would be to compare rare earths with spices. Although spices are used in moderation in cooking, their particular properties enhance the flavor and color of food, unlike other common ingredients. This analogy also works in the sense that, “more than 400 years ago, European powers competed with each other for access to and control of spice producing regions” (Ting, 2010, p. 58). Not surprisingly, the desire to mine rare lands in places of difficult access, such as the ocean’s depths or the moon, has become a growing interest of some state and private actors (Alvarez, Corzo et al., 2019). The United States Geological Survey (USGS) describes them as “vitamins” that, when added to other elements, produce results that could not be achieved on their own (Le Billon, 2004). In Japan, they use the following metaphor: “oil is the blood, steel is the body, and rare earths are the vitamins of a modern economy” (Klinger, 2017, p. 46). These metaphors convey an idea of the relatively small quantities required to achieve the desired effects, as most consumer electronics products require only a small quantity of rare earths. However, their distribution and the challenges involved in isolating the individual elements, as well as the fact that some rare earths are in fact rare, excite geopolitical passions around their scarcity; paradoxically, in places where rare earths are abundant, such as China, Brazil, and the United States (Figure 3).

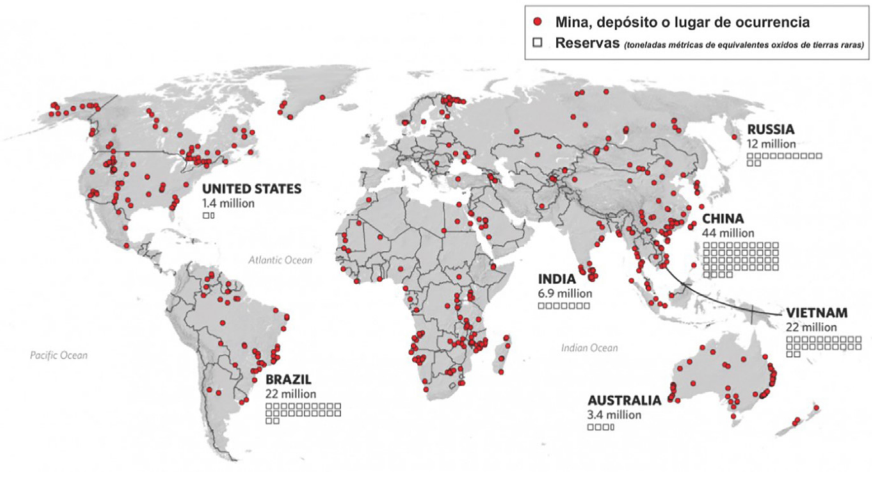

Figure 3. Global Distribution of Rare Lands.
Source: Stratfor (2019).

Although rare earths are essential to the technological infrastructure of modern life, they were of little use for almost a century after their discovery. The first successful application addressed the issue of producing light economically and reliably before the advent of urban electricity. At that time, Carl Auer von Welsbach's invention of the gas blanket, in the late 19th century, was in its preliminary phase of the industrial use of mixed rare earth elements. Although the gas blanket lantern contained only 1% cerium (Ce), its production scale was massive. According to Klinger (2017), more than five billion had been sold by the 1930s to provide city lighting networks before the widespread establishment of electricity grids.

Between 1930 and 1980, most rare earth applications were in the fields of catalysis, glass, ceramics, and metallurgy. It was only in the late 1980s that rare earth elements started to be used in innovative applications in communications and electronics (Figure 4). Figure 2 shows promethium (Pm) as one of the rare earth elements, which is occasionally excluded from the group because it is a synthetic radioactive element produced during nuclear fission and is only found in spent nuclear fuel on Earth[6] (Cardarelli, 2008). However, its use is indispensable for the production of the batteries that power pacemakers and spacecraft, as well as for making luminescent paint for wristwatches (Krebs, 2006).

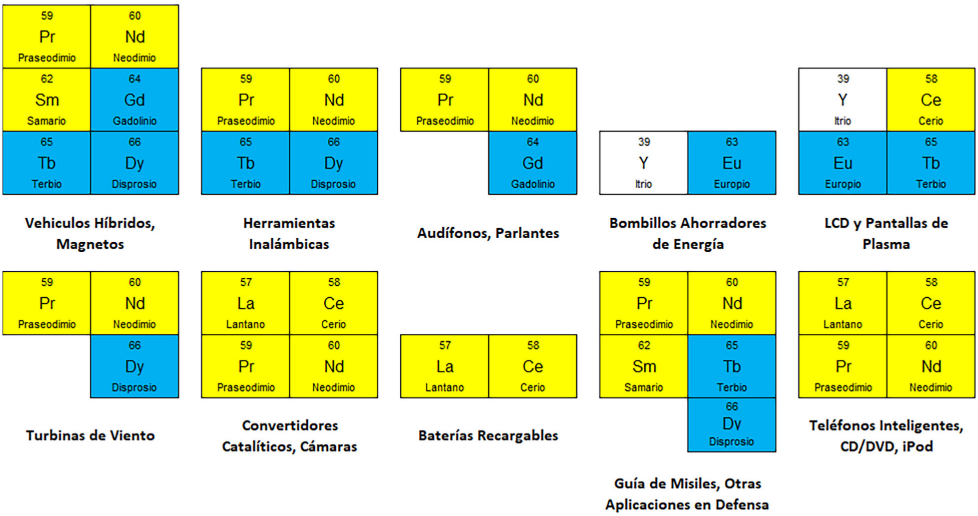

Figure 4. Some Technologies and their use of rare earths.
Source: Stratfor (2019).

Other rare earths, like thulium (Tm), are so rare that only a few kilograms of 500 tons of rare earth-rich minerals can be extracted (Emsley, 2001). Despite its scarcity,

6 It is also known to exist in the center of certain stars in the Andromeda galaxy (Álvarez, Benavides et al., 2019).

thulium is essential for the production of the surgical lasers used to treat neurological and prostate conditions (Duarte, 2010). Likewise, it is printed on euro banknotes as an anti-counterfeiting measure because it glows blue under UV light (Wardle, 2009).

Scandium (Sc), for its part, is very difficult to separate from other rare earths and uranium. World trade in this element still does not exceed 100 kilograms per year. However, it is used in metal halide lamps that illuminate streets, stadiums, and film studios (Krebs, 2006). It is part of the secret recipe for high-performance firearms, bicycle frames, and other sporting goods (Klinger, 2017). Other rare earth elements are not as scarce, but their uses are also comparatively broader. Because of their exceptional magnetic and conductive properties[7], they are essential to a diverse range of high-technology applications, and therefore to the prosperity, development, and security of most states in a globalized world.

In the military field, these elements are needed to produce the navigation components of the most advanced remote warfare technologies, such as drones and smart bombs (Abraham, 2015). They are also critical components of green technologies, such as wind turbines, solar panels, and hybrid fuel cell batteries (Krishnamurthy & Gupta, 2005). They are also essential in the development of nanotechnologies, as well as in the manufacture of consumer electronics products, such as smartphones, hard disks, and flat-screen monitors.

In information technology and consumer electronics, neodymium (Nd) is particularly important, as its exceptional magnetic qualities have enabled the miniaturization of computer hard drives and speakers. Without hard drives and small speakers, there would be no personal computers, smartphones, or wireless headsets. In fact, no other material comes close to the magnetic power of neodymium, making it, perhaps, the most promising applications of rare earth elements. Moreover, powerful neodymium magnets are essential for the latest and most efficient renewable energy technologies, including hybrid fuel cell batteries, water, and wind turbines[8], as well as solar panels.

Neodymium (Nd) and its alloys are also essential for the *hardware* of the contemporary military capabilities of states (Abraham, 2015), as they are found in cruise missiles, smart bombs, and drones. These types of weapons also contain praseodymium (Pr), terbium (Tb), samarium (Sm), and dysprosium (Dy). Yttrium (Y), europium (Eu), and terbium (Tb) are used in radar, sonar, and radiation detection devices

7 This is the case of erbium, which acts as an amplifier in optical fiber cables, allowing the construction of global networks for Internet communications.

8 A two-megawatt wind turbine contains about 360 kilograms of neodymium (Nd) and 60 kilograms of dysproe sium (Dy), while a hydraulic turbine of three megawatts contains 1800 kilograms of this rare earth (Klinger, 2017).

for urban, maritime, and air warfare. These same elements lend their optical properties to medical imaging devices, such as X-rays.

In summary, rare earth elements are the basic input for the *hardware* of global technological modernity. Without them, global finance, the Internet, satellite surveillance, oil transport, jet engines, televisions, GPS, and medical emergency rooms simply could not function.

A geopolitical game on the periodic table

On September 8, 2010, while patrolling near the disputed Senkaku/Diaoyu Islands in the East Asian Sea, a Japanese Coast Guard crew arrested the captain of a Chinese fishing vessel, whose crew was operating near the islands claimed as Japanese territory. The waters around these disputed islands contain fertile fishing grounds as well as potentially large deposits of oil and natural gas. During the 16-day diplomatic muddle between China and Japan over this arrest, the Chinese Government increased pressure on Japan to release the ship's captain through an embargo on rare earth metal exports to Japan (Klinger, 2017). This action caused substantial distress within the Japanese government and business elite circles because of their absolute dependence on rare earth imports from China, which are vital inputs for the manufacture of the high-tech products on which the Japanese economic model is based.

Thus, in combination with other forms of diplomatic pressure, the People's Republic of China used the rare earths as a coercive strategy to force Japan to comply with its demands. Finally, on September 24, 2010, the captain of the fishing boat was returned to China. At the time, China controlled 97% of global rare earth production. In contrast, Japan, lacking the natural availability of rare earths or substitutes, relied on the Chinese market for 80% of its rare earth requirements (Gholz, 2014). This crisis between China and Japan in 2010 pointed to how, for the first half of the 21st century, rare earths would be critical resources for the multidimensional security of state or non-state actors, increasingly dependent on advanced technologies.

The United States was the leading producer of rare earths until the 1990s; China did not produce significant quantities. However, Chinese companies enjoyed a combination of lower labor costs and relatively lax environmental regulations that provided incentives for the rare earth mining and processing industry in that country. Moreover, China's largest rare earth element mine also produced iron ore, which provided another source of income to help cover the permanent costs of the mine. In contrast, the largest mine in the United States closed in 2002, following complaints about the environmental damage caused by mining operations. At that time, the U.S. mine and processing plant required capital investment and a grueling round of environmental permit applications, which led the owners' to abandon mining activity in the United States. This decision made it easier for Chinese rare earth production to skyrocket.

Consequently, China has control over most of the market. In 2019, more than 80% of world production was concentrated in that country[9] (Figure 5). Chinese production of rare earth elements is geographically divided by type and highly concentrated in a handful of mines. Inner Mongolia accounts for almost 70% of China's production of LREE. A single mine in that region (the Baotou Bayan Obo mine) produces more than 50% of all Chinese rare earth elements (Stratfor, 2019). Southern China, where HREE were discovered in the 1960s, accounts for most of the country's HREE production. The Jiangxi province alone produces approximately 50% of China's LREE and HREE; Ganzhou city accounts for most of that production.

However, despite China's vast resources and large mines, its near-monopoly on the global supply of rare earth elements has been achieved by controlling the processing methods that extract the elements from the rock in which they are found. This control has represented a risk to the global supply; this became painfully evident in the mentioned 2010 conflict when China abruptly stopped the export of rare earth minerals, salts, and metals to Japan, a primary consumer. As an importer of many of the final products that Japan produces with rare earth elements, the United States felt a secondary impact from these measures. Although the ban was temporary, it sent shock waves through the global community when countries and producers were left struggling to try to find, develop, or reestablish alternative sources of rare earth elements to those in China.

In 2017, China produced more than 80% of the world's metals and rare earth compounds. Its rare earth exports to the United States accounted for 78% of US imports of these elements this year. During 2017, the United States imported over 17 000 tonnes of rare earth compounds, of which 10 000 tonnes were lanthanum (La) compounds, and 3 600 tonnes were cerium (Ce) compounds from China (Research and Markets, 2019). Despite China's quasi-monopoly on the production of rare earths in the world, its rare earth reserves fell sharply in the last decade, from 70% to 37% of global reserves by the end of 2016 (Klinger, 2017). In response, in the second half of 2018, to regulate rare earth mining, the Chinese Government started to close down illegal mining companies and reduce the rare earth production quota to 45 000 tonnes, 36% less than in the first half of the year (70 000 tonnes). Moreover, to improve its industry, China shifted from exporting raw minerals to exporting oxide products, which would have a major impact on the world market for rare earths.

9 Rare earth mining and refining in China is monopolized by six large state-owned companies.

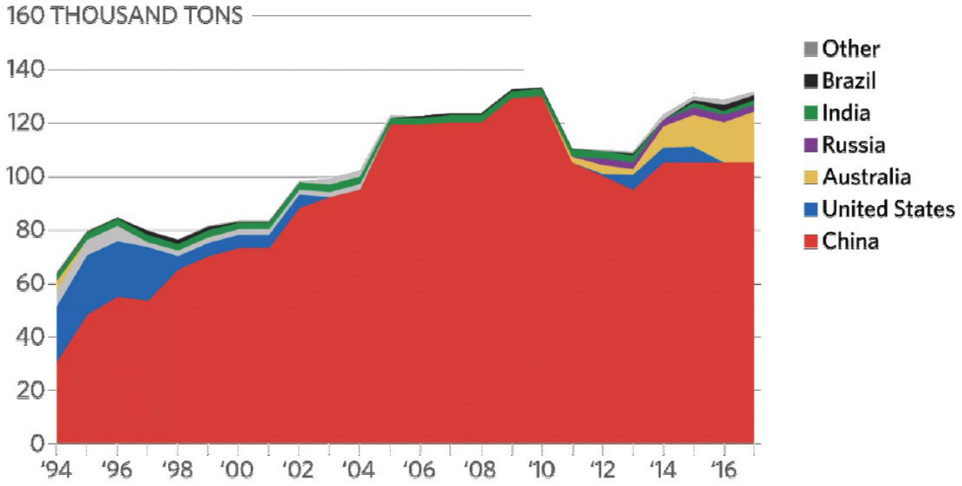

Figure 5. World production of rare earths by country.
Source: Stratfor (2019).

Despite the relatively small size of the rare earths market, it has managed to attract plenty of interest outside China in the light of the events of the diplomatic China-Japan dispute in 2010. When rare earth prices rose in 2010, hundreds of companies started raising money for new rare earth mining projects around the world. Motivated by the expected increases in demand, for 2010, investors in the United States, Japan' and Australia started opening rare earth mines and building new processing capacities. Other investors projected the potential of deposits in places as diverse as Canada, South Africa, Kazakhstan, Brazil, and Venezuela. As a result of these major investments, Molycorp in the United States and Lynas in Australia and Malaysia began delivering non-Chinese rare earths to world markets in 2013. Remarkably, some of these non-Chinese rare earth exports have been directed to the Chinese market.

In 2018, China only approved a quota of 115 000 tonnes of rare earth production, giving priority to meeting domestic demand. Chinese imports of rare earth oxide reached around 41 400 tonnes, increasing by more than 100% year-on-year (Research and Markets, 2019). These imports are mainly minerals and chemical concentrates from Myanmar[10] and the United States. In the case of American companies, they send lanthanum-rich minerals (La) to China, and then buy oxides and chemicals from that country.[11] Meanwhile, Myanmar became a key supplier of dysprosium (Dy), terbium (Tb), and gadolinium (Gd) to Chinese producers of magnets and alloys.

10 In 2018, China imported around 26 000 tonnes of rare earth carbonates from Myanmar, representing about 25% of the domestic demand. Myanmar's HREE accounted for almost one-third of the domestic consumption.

11 Among many other uses, Lanthanum (La) is used for oil refining.

These new non-Chinese sources have the potential to change the dynamics of the market profoundly. Thus, although Chinese producers will continue to provide the substantial majority of supply, competition from the rest of the world will moderate China's pricing power and feed into high-priority end uses, even in the event of a cut in all Chinese exports. However, China still controls the vast majority of all the production. Its control of some vital elements of MREE and HREE, such as dysprosium (Dy) and terbium (Tb) — needed to produce permanent magnets in electric vehicles and wind turbines— is almost complete, with over 98% of the global supply.

The Colombian case

For a couple of decades, there has been speculation that Colombia may have access to rare earth elements in its geography, contained mainly in coltan deposits[12], a type of ore widely used in the manufacture of electrical components. According to the *Agencia Nacional Minera* (ANM; National Mining Agency), there is no production of this mineral in Colombia, at least not legally. However, the illegal exploitation of coltan in the country has been carried out for several years by some actors outside the law, who, safeguarded by Colombia's empty spaces[13], profit from this lucrative business. According to Álvarez (2017), the main strategic corridors used by the networks dedicated to the criminal economy have been formed in the Colombian empty spaces. These structures allow them "the mobility of troops, food, medicines, weapons and other elements indispensable for the continuity of the war, as well as drugs, trafficking of species, illegal mining, trafficking of migrants, etc." (p. 368)

According to InSight Crime, dissidents of the Revolutionary Armed Forces of Colombia (FARC) have been involved in coltan mining in eastern Colombia for several years[14] (Figure 6). In 2011, the former director of the National Police declared that the Sinaloa Cartel was working with the FARC to exploit and commercialize coltan. In 2014, Colombian security forces captured Juan José Rivera Suárez (known as "the coltan czar"), a FARC and ELN middleman facilitating the sale of illegally mined coltan from protected indigenous reserves in the Colombian territory to international

12 Coltan is a black, opaque, metallic mineral composed of the minerals columbite and tantalite, and is relatively rare in nature. Because the interest in mining coltan would be mainly based on being able to extract tantalum (Ta), the value of coltan would, therefore, depend on the percentage of tantalite (between 20% and 40%) and the percentage of tantalum oxide contained in the tantalite (between 10% and 60%).

13 According to Alvarez (2017), an empty space is "an area of demographic void, characterized by low population densities, predominance of illegal structures oriented towards the illegal use of natural resources and other criminal activities, low levels of infrastructure and weak state penetration." (p. 368)

14 Seemingly, there are important reserves of tantalum (Ta) in the form of coltan deposits in the departments of Guaviare and Vaupés.

markets, such as the United States. During Rivera's capture, Colombian authorities seized 375 kilos of minerals, including uranium[15] (InSight Crime, 2014).

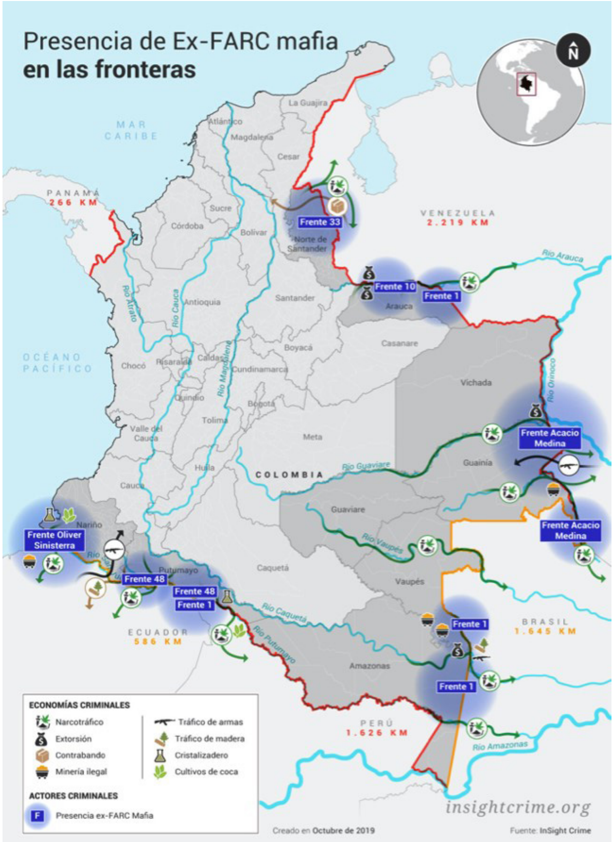

Figure 6. Presence of FARC dissidents at the borders
Source: InSight Crime (2019).

Similarly, ELN guerrillas and FARC dissidents not participating in the peace process have been mining gold, diamonds, and coltan since 2016, in the Venezuelan states of Bolivar, Apure, and Amazonas. The two latter border with Colombia (Figure 7). According to Álvarez & Luna (2018), for more than three decades, there have been Colombian armed structures on the Colombian-Venezuelan border dedicated to transnational crime. In association with the Venezuelan State and non-state actors, they manage the business of drug trafficking and illegal mining in that region.

15 According to documents seized from Raul Reyes' computer during Operation Phoenix, the FARC was also involved in uranium (U) trafficking.

By organizing the miners to exploit, transport, and deliver the resource to Nicolas Maduro's regime, FARC and ELN dissidents would currently have a formal job in the Venezuelan mines.[16] For some time, this government has resorted to mining as a new source of income in the face of declining oil production. It is believed that these networks of criminal convergence (Álvarez y Zambrano, 2017) make monthly profits of approximately US$10 million (Lares, 2018).

Figure 7. Criminal activities of FARC dissidents in Venezuela
Source: InSight Crime (2019).

In May 2018, Venezuela made its first export of coltan composite to Italy. It consisted of 10 pallets weighing a total of 5 tonnes and worth EUR 300 000. The weight of this export suggests that some of the exported coltan probably came from

16 These activities of exploitation and delivery of gold and coltan to the Venezuelan Government used to be carried out by "pranes" (Venezuelan criminal groups).

illegal mines in Colombia, as the deposits in Venezuela are not sufficiently developed to meet the quota.

This dynamic is reminiscent of wars over resources in other latitudes, such as the Democratic Republic of Congo, which ostensibly holds 80% of the world's estimated coltan reserves. However, it is the neighboring country of Rwanda that appears as one of the primary producers at the world level, despite not having reserves of this mineral. Because coltan is considered a highly strategic non-renewable natural resource, since 1998, there has been a war for the control of the deposits of this mineral in the Congo. The Rwandan Defense Forces have set up a structure in the Congo to supervise the mining of coltan and the transfer of the mineral to Rwanda, where it is finally processed and exported. It is no coincidence that approximately 21% of the world's supply of tantalum (Ta) in 2018 came from conflict regions.

Conclusions

The 17 elements that make up the rare earths, in combination with other substances, are unique materials with magnetic, conductive, and energy storage properties. These distinctive properties enable them to be used in technologically advanced activities, including social networking, internet browsing, computing, digital shopping, driving hybrid vehicles, autonomous aircraft, computer hacking, and the development of modern warfare. In this sense, they are essential to the information technology revolution, on which humans depend on for communication, trade, and, increasingly, armed conflict.

The contemporary dominance of the People's Republic of China on the exploitation of rare earth determines the global geography of its mining and exploration. It is also influenced by the global integration of this state and the concomitant geopolitical developments, in general. China has approximately one-third of the world's reserves of rare earth elements. It has recently come to dominate the sector after discovering new reserves in the 1960s and overtaking the United States as the world's leading producer of these elements in the early 1990s. In the short term, China will continue to benefit from the monopoly of these strategic natural resources. However, its growing domestic demand has ultimately begun to limit the duration of its control over the sector, and production is already being diversified.

Therefore, safeguarding immediate access to rare earths ensures that states can continue to reap the social, economic, and political benefits of information technologies, transportation, and energy production and storage. Rare earths are thus a strategic natural resource that states are currently competing for, and they will continue to seek their control for years to come. The lack of access to a strategic natural resource, which is a commodity, constitutes a security risk in terms of economic prosperity and defense.[17] The scarcity of rare earths could contribute to unfavorable economic and political outcomes for states. In this case, the privation of rare earths would hinder technological innovation and function, as well as its production rewards.

The advantage of recognizing that rare earths are a strategic natural resource with security risks is that academics and public policymakers have an opportunity to develop risk mitigation policies before these types of minerals become a threat to the multidimensional security of the state. Academics, such as Dobransky (2012), Massari and Ruberti (2013), Wübbeke (2013), Campbell (2014), Gholz (2014), Golev et al. (2014), and Machacek and Fold (2014), among others, have warned that rare earth elements, as strategic natural resources, are an issue that should be addressed by security and defense studies. The implications of supply and demand of these resources on the economic performance and military industry of states are increasingly sensitive.

In this sense, Colombia's potential involving the extraction of some special metals is promising, not only to participate in the global demand for this type of metal but also to guarantee its internal demand. According to the National Mining Agency (2015), in the departments of Vichada, Guainía, and Vaupés, "occurrences of niobium (Nb) and tantalum (Ta) associated with pegmatites, alkaline granites and alluvial, eluvial and residual deep-meteorite placers are reported; and they are also related to rare earth deposits." (p. 14). Furthermore, as it is already widely recognized, Colombia is privileged in terms of carbon resources at a global level, and, according to Henao (2019), several studies show that there is a high probability of rare earth elements in this type of fuel. Moreover, the concentrations of rare earth elements in Colombian coals are higher than global averages. Uranium (U), for instance, is found in a wide variety of lithologies, mainly in sedimentary rocks in the eastern and central mountain ranges and the department of Guainía.

Colombia's production potential of rare earth elements and other special metals, such as tantalum (Ta) and niobium (Nb), as well as uranium (U), must be part of the strategic design of state security and defense. More so when the current exploitation of some of these minerals is under the control of transnational organized crime. Illegal groups have used the extraction of these resources as a viable source of financing for their illegal activities, which ultimately affects Colombia's multidimensional security.

Indeed, FARC and ELN dissidents, in alliance with the Venezuelan regime, exchange in tungsten and tantalum extracted from the depths of the Colombian Amazon rainforest. The merchants of these criminal groups transport bags of crushed

17 A security risk is less urgent than a security threat, which implies the existence of a political entity in grave danger.

rocks along the Inírida and Orinoco rivers, and then use trucks to transport them to Bogotá or Caracas, where they are subsequently delivered to commercial companies that sell the rocks to international markets. Then, they are converted into alloys or powders needed for a wide range of components used by various companies, such as BMW, Hewlett-Packard, and Samsung Electronics; this adds further complexity to the confluence of legal and deviant globalization (Álvarez & Zambrano, 2017).

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About the authors

Carlos Enrique Álvarez Calderón is a Political Scientist and holds a Master's in International Relations from the Universidad Javeriana. He is a fellow of the Center for Hemispheric Defense Studies "William Perry" in Washington. He is a Military Intelligence Combat Support Command advisor, professor, and principal researcher at the "General Rafael Reyes Prieto" War College. Editor of *Essays on Defense and Security*.
https://orcid.org/0000-0003-2401-2789 - Contact: carlos.alvarez@esdegue.edu.co

John Heberaldo Trujillo Palacio is a Lieutenant Colonel. A professional of the Escuela Militar de Cadetes "General José María Córdova," and a logistic administrator, specialist, and Master's candidate at the Escuela Superior de Guerra "General Rafael Reyes Prieto." He works as an administrative analysis officer for the Colombian Army's Directorate for the Application of Transparency Standards.
https://orcid.org/0000-0002-1874-4695 - Contact: john.trujillopa@buzonejercito.mil.co

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