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THE GLOBAL LANDSCAPE OF STRATEGIC AND CRITICAL MINERALS FROM THE PERSPECTIVE OF MICHAEL EUGENE PORTER'S FIVE COMPETITIVE FORCES

O PANORAMA MUNDIAL DOS MINERAIS ESTRATÉGICOS E CRÍTICOS SOB A ÓTICA DAS CINCO FORÇAS COMPETITIVAS DE MICHAEL EUGENE PORTER

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ABSTRACT

This work addresses Michael Eugene Porter's Five Competitive Forces as a strategic management tool to be used by high-level managers and decision-makers regarding Strategic and Critical Minerals, allowing them to assess the repositioning and competitiveness of businesses in the face of an intense geopolitical mineral landscape. It explains the factors related to the five competitive forces and evaluates the global scenario of strategic and critical minerals in light of the precepts established by Porter. This research adopted a qualitative approach to assess the current situation of mineral resources in the repositioning and competitiveness of entities that conduct the exploration of Strategic and Critical Minerals. The procedure used was a literature and documentary review, which involved consulting sources classified into two categories: sources that presented the definitions and explanations of Porter's Five Competitive Forces; and sources that evaluated the international landscape of Strategic and Critical Minerals in light of Porter's established precepts. Studies have shown how feasible it has been to apply Porter's Five Forces to the current mineral geopolitics, enabling high-level decision-making by managers, entrepreneurs, and industrialists in conducting policies aimed at the mineral industry, with an emphasis on market repositioning and competitiveness.

Keywords: Strategic Minerals; Critical Minerals; International Overview; Michael Porter; Competitiveness.

RESUMO

Este trabalho aborda as Cinco Forças Competitivas de Michael Eugene Porter como ferramenta de gestão estratégica a ser utilizada por gestores e decisores de alto nível quanto aos Minerais Estratégicos e Críticos, permitindo-lhes avaliar o reposicionamento e

a competitividade dos negócios ante a um intenso panorama geopolítica mineral. Explica os fatores relacionados às cinco forças competitivas; e avalia o cenário global dos minerais estratégicos e críticos à luz dos preceitos estabelecidos por Porter. Esta pesquisa adotou uma abordagem qualitativa para avaliar a atual conjuntura dos recursos minerais no reposicionamento e competitividade dos entes que conduzem a exploração dos Minerais Estratégicos e Críticos. O procedimento utilizado foi a revisão da literatura e documental, que envolveu a consulta a fontes classificadas em duas categorias: fontes que apresentassem as definições e explicações das Cinco Forças Competitivas de Porter; e fontes que avaliassem o panorama internacional dos Minerais Estratégicos e Críticos à luz dos preceitos estabelecidos de Porter. Os estudos apontaram o quanto foi viável aplicar as Cinco Forças de Porter na atual geopolítica mineral, permitindo a tomada de decisão de alto nível de gestores, empresários e industriais na condução de políticas voltadas à indústria mineral, com ênfase ao reposicionamento no mercado e a competitividade.
Palavras-chave: Minerais Estratégicos; Minerais Críticos; Panorama Internacional; Michael Porter; Competitividade.

1. INTRODUCTION

As rapid transformations observed since the beginning of the twenty-first century demonstrate the extent to which societies have evolved from economic, industrial, and scientific-technological perspectives. The remarkable expansion of communication and transportation systems has enabled global integration on a scale and within timeframes that were previously unimaginable.

The emergence of the Fourth Industrial Revolution, with its direct impacts on digital transformation and production systems, has driven investments in research and the development of high-value-added technologies, continuously reshaping the everyday life of contemporary societies.

Alongside industrial development, fossil fuels have remained a major driver of economic growth, contributing to the continued emission of greenhouse gases into the atmosphere. As sustainable development has not progressed *pari passu* with global warming, nations have been confronted with the pressing need to mitigate the consequences of climate change.

Under these circumstances, mineral resources, among other solutions, have assumed a prominent position on the global agenda because of their application in disruptive, low-carbon, and sustainable mobility technologies. Given the need to explore, process, and commercialize these resources, mineral commodities have become highly important strategic assets for several industrialized and developing countries.

As a result of the accelerated consumption of mineral resources, their economic and technological relevance, and growing pressures on global supply chains, several countries have classified certain minerals as strategic or critical. Consequently, the international market has undergone a series of transformations involving mineral-producing, consuming, importing, and exporting countries.

Within this context, the current challenge lies in gaining access to these natural resources while managing them appropriately and in a timely manner for the industrial production of goods, products, and

services with high economic value. To achieve this objective, strategic management provides decision-support tools that enable senior managers to assess the competitiveness of strategic and critical mineral-related activities in the global market.

Accordingly, this research addresses the following question: how can a management tool be employed to assess the international landscape of Strategic and Critical Minerals in a context in which these resources have become indispensable to economic and technological development in the twenty-first century?

One possible approach is the application of Porter's Five Competitive Forces, which motivated their use in this study as a framework for understanding how Strategic and Critical Minerals may contribute to strengthening countries' positioning within the international arena amid an environment of intense economic competition arising from the energy, environmental, and technological transformations of the twenty-first century.

Regarding the methodology, a qualitative approach was adopted. In terms of research procedures, the study was based on bibliographic and documentary research involving national and international publications, scientific articles, Brazilian government agencies, international organizations, multinational institutions, and Internet-based sources. The consultation and systematic consolidation of these sources made it possible to identify the most relevant issues addressed in the study.

Thus, the general objective of this study is to analyze the global landscape of Strategic and Critical Minerals from the perspective of Michael Eugene Porter's Five Competitive Forces. Based on this

analysis, the study seeks to provide political, economic, and scientific-technological institutions with analytical support for a comprehensive understanding of the competitiveness and positioning of the mineral sector in view of the challenging and complex scenarios emerging in the twenty-first century.

To achieve this purpose, the specific objectives are to explain the concepts and definitions underlying Porter's Five Competitive Forces and to assess the global landscape of Strategic and Critical Minerals through the lens of these competitive forces, ultimately examining the suitability of their application as a strategic management tool to support the competitiveness of these mineral commodities.

Accordingly, this article is structured into four sections, providing a comprehensive analysis of the application of Porter's Five Competitive Forces to the current landscape of Strategic and Critical Minerals. The first section, Introduction, presents the central theme of the study. The second section, Methodology, describes the research approach adopted, including data collection and analysis strategies. The third section, Theoretical Framework, provides an explanation of Porter's Five Competitive Forces as a strategic management tool and examines the global landscape of Strategic and Critical Minerals from the perspective of these competitive forces.

The final section, Conclusions, synthesizes the main findings of the research and provides political, economic, and scientific-technological institutions with analytical support for a comprehensive understanding of the competitiveness and positioning of Strategic and Critical Minerals in the face of the

challenging and complex scenarios emerging in the twenty-first century.

2. THEORETICAL FRAMEWORK

This theoretical framework was organized into two subsections. The first presents the definitions and explanations of the management framework developed by Michael Eugene Porter. The second and final subsection aims to assess the international landscape of these mineral commodities, supporting high-level decision-makers in understanding the importance of applying this framework to strengthen the positioning and competitiveness of mineral resource-related businesses within a highly dynamic and geopolitically complex global environment.

2.1. Definitions And Explanations Of Porter's Five Competitive Forces

Described in his seminal 1979 article published in *Harvard Business Review*, Michael Eugene Porter's ideas revolutionized the field of strategy and continue to shape business practice to this day. The Five Forces analysis can help companies assess industry attractiveness, the competitive profile of the business environment, the areas in which they should compete more effectively, and how they can position themselves for success (*Harvard Business Review*, 2026; Montevirgen, 2026).

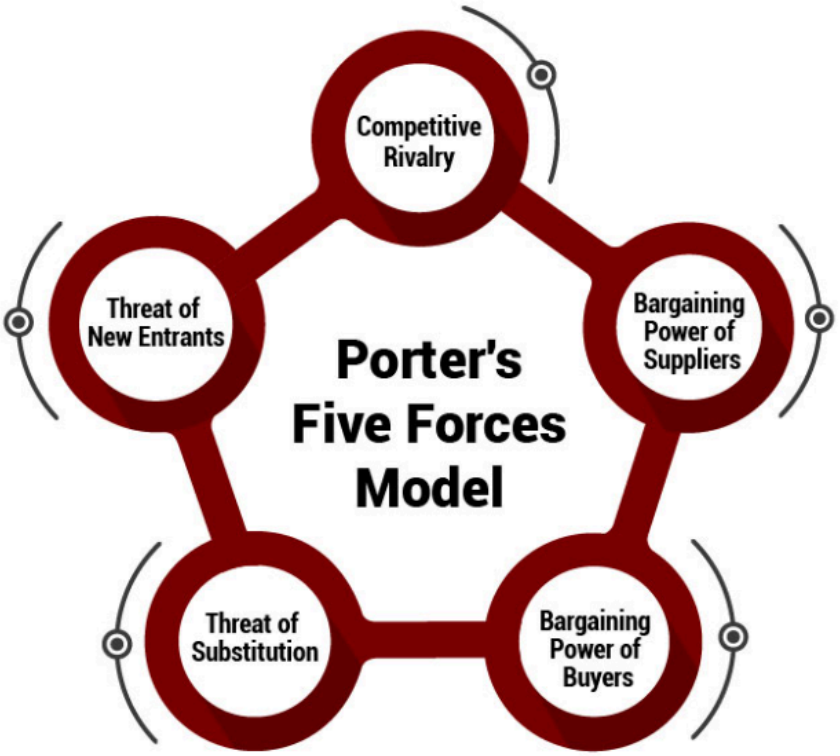
The Five Forces constitute a framework for achieving success against competitors across different industries. By highlighting the major threats facing a company, this framework has long been regarded as a reference for understanding how organizations can "win" in business (WEF, 2025). Furthermore, the model examines the key

forces that shape the long-term profitability potential of industries operating in the market. By considering the cumulative impact of these forces, which permeate industrial environments, organizations can develop more resilient positions within competitive settings (*Strategy Institute*, 2024).

As markets become increasingly globalized, companies seek competitive advantages to strengthen their presence and remain active in highly dynamic environments. Consequently, a well-defined business strategy becomes increasingly important, as it enables organizations to understand market conditions while incorporating capabilities that are relevant to their efficient operation (Mendonça et al., 2017; Gontijo; Gessner, 2015 *apud* Francisquette, 2023).

It is not surprising that markets undergo continuous transformations, including the entry of new businesses, the emergence of new competitors, the adoption of new work patterns, and the incorporation of new technologies, all of which affect how organizations formulate and implement their plans. Therefore, establishing a connection between an organization and the environment in which it operates is fundamental to developing an appropriate competitive strategy (Barboza; Rojo, 2015 *apud* Francisquette, 2023).

Figure 1. Michael Eugene Porter's Five Competitive Forces



Source: *The Strategy Institute* (2024).

Under these circumstances, Porter's Model (Figure 1) provides a strategic analysis that assists managers in understanding and shaping industry structure in order to balance competitive forces and maximize profitability. It can also be used to obtain a comprehensive understanding of the business and the environment in which it operates, thereby contributing to strategic decision-making (Blackmore, 2024).

Thus, Porter's Five Forces comprise: (1) competitive rivalry within a market; (2) the bargaining power of suppliers; (3) the bargaining power of buyers; (4) the threat of substitute products; and (5) the threat of new entrants (Montevirgen, 2026).

2.1.1. Rivalry Among Competitors (Competitive Rivalry Within An Industry)

In general terms, rivalry among competitors is reflected in the intensity of competition among companies, industries, and service

providers seeking to capture larger market shares through, for example, more competitive prices, after-sales support, quality, and payment conditions.

Several circumstances may influence the intensity of rivalry within an industry. Among the most relevant are the number of competitors, as greater numbers tend to intensify rivalry; the similarity of products offered, since industries selling highly similar products tend to be more competitive; and customer loyalty, with rivalry generally increasing when customers demonstrate low loyalty to a particular product (CFI, 2020).

Finally, within this competitive environment, new competitors may represent an additional threat, intensifying competition that already exists. Depending on market positioning and customer perceptions, the level of rivalry may be high. In other circumstances, competition may remain relatively low because of the limited number of competitors. Nevertheless, markets tend to evolve continuously as new entrants emerge or established competitors adopt new strategies (OCM, 2016).

2.1.2. Bargaining Power Of Suppliers

Under this Porter Competitive Force, suppliers of inputs, raw materials, and services used throughout a production chain may directly influence the performance of their customers. Within this bilateral commercial relationship, suppliers may, depending on prevailing circumstances, influence the prices, quality, and quantities of inputs used in the buyer's production process, thereby affecting costs and profitability, particularly when a supplier is able to monopolize a market and provide exclusive products.

Thus, within an industrial context, companies depend on the supply of raw materials to maintain their productive activities and, depending on market conditions, may experience reduced profitability when suppliers provide products considered exclusive, indispensable, or integrated into the value chains of other buyers (Strategy Institute, 2024).

Accordingly, Porter argues that suppliers possess a certain degree of bargaining power over demanding firms based on their pricing and supply conditions. For example, when there are fewer suppliers than buyers, suppliers may increase input prices because they have greater bargaining power relative to buyers. Conversely, when there are more suppliers than buyers, buyers gain greater bargaining power, placing them in a stronger position to negotiate more favorable terms and costs with suppliers (OCM, 2016).

As will be analyzed below, the global market for Strategic and Critical Minerals, depending on the mineral commodity, its economic importance, and its technological and industrial value, has been granting greater bargaining power to producing and exporting countries, which occupy the position of suppliers.

2.1.3. Bargaining Power Of Customers (Buyers)

For Michael Eugene Porter, the bargaining power of customers in a competitive market is characterized by their ability to pressure suppliers to offer lower prices and/or to guarantee the purchase of products, goods, and services with higher quality. When there are few customers relative to a larger number of suppliers, this bargaining power tends to be greater.

At the expense of business profitability and returns, strong buyer power may reduce the prices of purchased goods while demanding higher quality or service levels from suppliers. Customer bargaining power is also greater when there is a larger number of sellers in the market (Blackmore, 2024).

Buyers also tend to have greater bargaining power when the supply of a product exceeds demand, allowing them to pressure companies to offer higher quality at lower prices. Conversely, buyers' bargaining power decreases when supply is lower than demand (OCM, 2016).

In the global market, do countries that purchase Strategic and Critical Minerals, given their national economic importance, have bargaining power vis-à-vis supplying countries? Under certain circumstances, the answer may be affirmative, and this issue will be examined throughout the assessment of the current international landscape of the mineral industry.

2.1.4. Threat Of Substitute Products

Substitute products are those that enter the market with functions similar or identical to those of existing products while still meeting the expectations of customers and buyers (Barney, 2011 *apud* Rodrigues, 2016). Accordingly, markets may offer alternatives capable of satisfying the same consumer need. Their prices are often lower, attracting buyers through more advantageous offers (Strategy Institute, 2024).

For a clearer understanding, examples of established products and alternative products include cable television and streaming services; smartphones and digital cameras; beef and chicken; face-to-face

courses and online classes; coffee and tea; and soft drinks and fruit juice, among others.

According to Michael Porter, companies are likely to face a high threat from substitute products when switching costs for buyers are justified by more advantageous prices compared with established products and when substitutes offer superior attributes or performance characteristics (CFI, 2020).

Therefore, when viable alternatives are available in the market that can satisfy the same consumer needs, customers are likely to consider them when making purchasing decisions. To mitigate the threat of substitutes, organizations need to pursue differentiation, which may be achieved through a strong brand or product patents, among other mechanisms (OCM, 2016).

Can this competitive force be applied to the market for Strategic and Critical Minerals? Are alternative products currently available for these mineral commodities? These questions will be addressed throughout the assessment of the global landscape of these economic resources.

2.1.5. Threat Of New Competitors Entering The Market (New Entrants)

Under this final Competitive Force proposed by Porter, the risk to businesses arises from the entry of new companies into a given economic sector, bringing new capabilities, services, and products to the market.

When an industry becomes profitable, it generally attracts new competitors. If entry barriers are low, new entrants may readily

capture market share and threaten the profitability of established companies. These new competitors often introduce lower prices and more attractive options to the sector in which they intend to operate (Blackmore, 2024).

This threat therefore refers to the ease or difficulty with which new competitors can enter a market. Industries such as automobile manufacturing, which require substantial capital investment, are less vulnerable to the entry of new competitors (RBS, 2024).

Accordingly, when a market is particularly profitable and demand exceeds supply, it is likely to attract new competitors, thereby reducing the profitability of companies already operating in that market. This threat can be managed through various mechanisms, including patents, brand strengthening, government policies, and regulation (OCM, 2016).

Based on all the explanations presented, it can be inferred that securing competitive advantages is vital in a highly competitive business environment. Under intense competition, organizations need to continuously assess their strategic positioning in order to sustain profitable growth, supported by a framework that enables them to interpret market dynamics and obtain timely insights. One way of preparing for such conditions is through systematic monitoring of Porter's Five Forces (Strategy Institute, 2024).

There is no denying that markets change over time. Buyers or suppliers may become more or less influential; technological or managerial innovations may make the entry of new competitors more or less likely; and regulatory changes may alter the intensity of rivalry or affect entry barriers. Strategic decisions made by

competitors may also influence the direction of businesses. It is within this dynamic context that Porter's Five Forces analysis becomes particularly relevant for anticipating and responding to market changes (Harvard Business Review, 2026).

Therefore, these analyses are important for understanding the competitive environment in which an organization operates. By assessing them, companies can identify external pressures that may affect profitability and facilitate the development of strategies to protect themselves against threats or capitalize on emerging opportunities (RBS, 2024).

The following section assesses the complex and dynamic global landscape of Strategic and Critical Minerals through the lens of Porter's Five Competitive Forces, enabling a more comprehensive understanding of the positioning and competitiveness of businesses, industries, and countries involved in the exploration of these mineral resources.

2.2. Global Landscape of Strategic and Critical Minerals in Light of Michael Eugene Porter's Five Competitive Forces

Regarding rivalry among competitors, Porter's first Competitive Force has been significantly influenced by the sharp increase in demand and intense international competition to secure access to supplies of Strategic and Critical Minerals. Consequently, several countries have pursued initiatives aimed at expanding their capacity, independence, and autonomy to produce, process, and commercialize these mineral commodities, thereby strengthening their position within an increasingly competitive global environment.

Studies indicate that demand for Strategic and Critical Minerals continued to increase substantially in 2024. Lithium demand rose by nearly 30%, while demand for nickel, cobalt, graphite, and rare earth elements increased by between 6% and 8% in 2025. This growth was largely driven by electric vehicles, battery energy storage, and electricity grids. In the case of copper, the rapid expansion of investment in China was the primary factor behind demand growth over the previous two years. The energy sector accounted for 85% of the growth in demand for battery metals, including lithium, nickel, cobalt, and graphite (IEA, 2025 *apud* Bezerra, 2025).

This trend is expected to intensify significantly through 2034, driven by the expansion of electricity generation and transmission systems. The minerals expected to experience particularly strong demand include graphite, phosphorus, lithium, and rare earth elements, largely as a result of vehicle electrification and the increased use of rechargeable batteries (Brasil, 2025). In this context, national policies may constitute a response to the growing intensity of international commercial competition while expanding economic opportunities through the use of specific minerals in targeted applications (Castro; Peiter; Góes, 2020).

Finally, studies conducted by Kursunoglo and Kursunoglo (2022) have highlighted the extent to which Strategic and Critical Minerals, particularly Rare Earth Elements, are indispensable to the energy transition, including the manufacture of wind turbines, photovoltaic panels, electric vehicles, and energy-storage batteries. These applications have consequently contributed directly to intensifying competition among countries seeking to secure access to these mineral resources.

Regarding Porter's second Competitive Force, **the bargaining power of suppliers,** the abundant availability of mineral resources and the capacity to exploit them more efficiently from an economic perspective may provide supplier countries with stronger negotiating positions in international markets.

It is important to note that the geographical concentration of critical minerals is higher than that observed for oil, natural gas, and coal. These circumstances contribute to making global supply chains more sensitive to geopolitical and economic instability, particularly in view of the emerging bipolar configuration of the international order in the post-pandemic context. Such conditions may affect exports, supply-chain resilience, and the prices of these mineral commodities (Castro; Santos; Aquino, 2022).

Accordingly, the concentration of mineral production and supply has influenced international geopolitics, leading countries and economic blocs to formulate differentiated strategies for raw materials classified as critical. These strategies encompass commercial and industrial policies designed to secure access to strategic resources. Documents issued by the European Union and the United States highlight China's relevance as the leading source of supply for minerals classified as critical (Fortier et al., 2018; EC, 2021).

Brazil, for example, is widely recognized as a global leader in the production and export of mineral commodities, particularly metallic minerals, with notable production of iron ore, copper, gold, aluminum, and niobium (Castro; Peiter; Góes, 2022). The country also holds the world's largest niobium reserves, concentrated primarily in Araxá, Minas Gerais, where the world's largest niobium mine is

located. This mineral is strategic and widely used in the production of high-performance metal alloys, particularly in the steel and aerospace industries (CEBRI, 2025).

Additionally, Brazil's subsoil contains proven reserves of rare earth elements, vanadium, tantalum, bauxite, and graphite. These mineral commodities are positioned at the center of the current economic transformation associated with the Fourth Industrial Revolution and constitute important inputs for the defense and renewable energy industries. The development of these deposits could therefore strengthen Brazil's integration into high-value-added value chains while contributing to the generation of higher-income employment opportunities in the twenty-first century (Brasil, 2025).

Another country that stands out as a supplier and global actor in mineral resources is China. According to the Chinese Geological Survey, since 1999, a series of mineral deposits have been identified through mineral exploration and resource assessment activities, contributing to an expansion of the country's reserves, as presented in Table 1:

Table 1. Mineral Deposit Discoveries in China Since 1999

Mineral Resource	Estimated Reserves
Coal	130 billion tons
Iron	5 billion tons
Potassium	460 million tons
Manganese	180 million tons
Lead and zinc	83 million tons

Copper	38 million tons
Tin	2.6 million tons
Tungsten	750 thousand tons
Silver	80 thousand tons
Gold	1,800 tons

Source: *China Geological Survey* (2013)

As of 2009, the Asian country already accounted for 98% of the global rare earths market, and its near-monopoly position was attributed to its low labor costs and limited regulatory costs, which contributed to lower mineral prices and reduced the participation of other countries in the market. China's leading position in the rare earths segment resulted from sustained research and development efforts associated with its domestic industry (USGS, 2015; Shen; Moomy; Eggert, 2020; Haxel; Hedrick; Orris, 2002 *apud* Castro; Peiter; Góes, 2022).

Mineral processing is highly concentrated in China, which refines 90% of rare earths and between 60% and 70% of lithium and cobalt. The country also controls more than 75% of global industrial production of solar panels and electric vehicle batteries. Accordingly, China has increased its participation in the global market for electrolyzers and wind power generation equipment (Castro; Santos; Aquino, 2022).

It is worth noting that China's industrial policy reflects a strong interest in securing competitive advantages for its industries and controlling export-oriented trade, thereby enabling the country to maintain competitive prices in international markets (Shen; Moomy;

Eggert, 2020 *apud* Castro; Peiter; Góes, 2022). These measures led to a dispute involving the United States, the European Union, Japan, and other countries, which filed a complaint with the World Trade Organization alleging violations of trade rules, particularly in relation to Chinese restrictions on exports of rare earth elements, tungsten, and molybdenum (Castro; Peiter; Góes, 2022).

This explains why, when more than half of the global production of a given raw material is concentrated in a single country, other importing countries become dependent on that supplier country, which consequently acquires considerable influence over prices and the quantities traded. This was the situation that emerged in China between the late 1990s and the 2000s with respect to rare earth production and exports, when the country achieved a global monopoly in this market (Reis Melo, 2017).

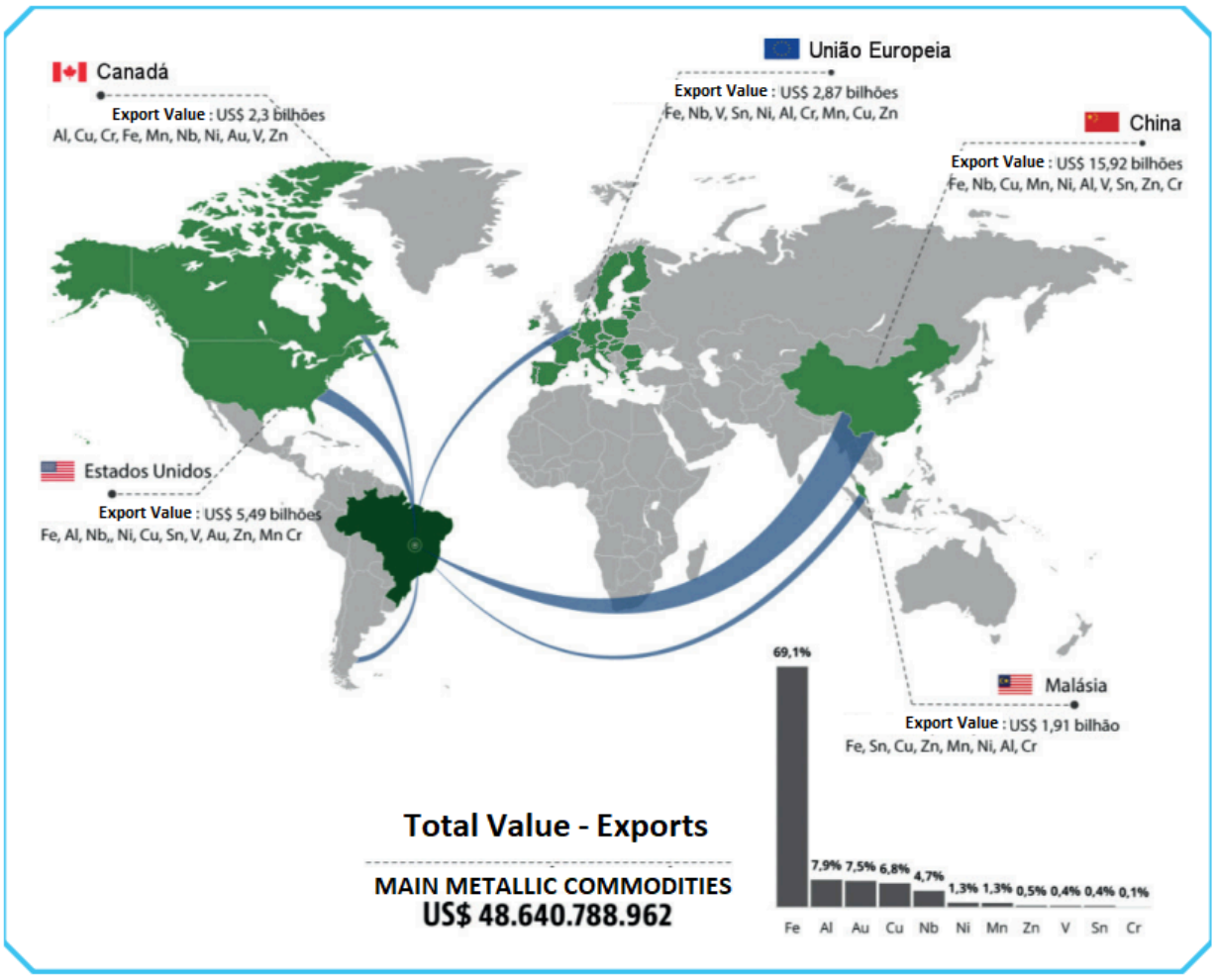
In specific geopolitical circumstances involving armed conflicts, other factors may strengthen suppliers' bargaining power. One example would be a potential naval blockade of the Strait of Hormuz in the Middle East resulting from a conflict between the United States and Iran, a situation that could benefit the Russian Federation.

Approximately one-third of the global fertilizer supply passes through the Persian Gulf–Arabian Sea route. Between 2023 and 2025, Iran, Qatar, and Saudi Arabia accounted for 36% of global urea exports, making this route particularly relevant to the international supply of the nitrogen fertilizer most widely used in global agriculture and fundamental to food security. If this route were disrupted, these three countries would cease to supply the international market. In this context, Russia, the world's second-

largest fertilizer producer and largest exporter, would emerge as an alternative supplier for the global chain of these non-metallic mineral resources, potentially transforming fertilizer supply into an instrument of diplomatic, commercial, and economic bargaining, not only for the Global South but also for the United States and Europe, thereby favoring greater flexibility regarding Western sanctions imposed on the country (Lira, 2026).

Regarding Porter's third Competitive Force, **the bargaining power of customers,** China occupies a privileged commercial position in relation to Brazil, as it has been, in recent years, the main destination for Brazilian exports of mineral commodities, including iron, niobium, copper, manganese, nickel, aluminum, vanadium, zinc, and chromium. China accounted for 27.7% of the total value of Brazilian exports, corresponding to US$12.85 billion (Castro; Peiter; Góes, 2020). This leading position remained consistent in subsequent years, when China's share increased to 32.7% of Brazil's total exports, equivalent to US$15.92 billion (Castro; Peiter; Góes, 2022). At the end of 2024, China remained the main destination for Brazilian mineral extraction industry exports, absorbing 62.9% of Brazil's external sales, equivalent to USD FOB 4.635 billion (ANM, 2024).

Figure 2: Destinations of Brazilian Exports of Metallic Mineral Commodities (2019)



Source: National Mining Agency (2020) *apud* Castro, Peiter and Góes (2022).

Another country with bargaining power in relation to Brazil, due to its large-volume purchases, is the United States (Figure 2), which has maintained its position as the second-largest destination for Brazilian mineral exports, including iron, aluminum, niobium, nickel, copper, tin, vanadium, gold, zinc, manganese, and chromium. The country accounted for 11.3% of these exports, equivalent to US$5.49 billion (Castro; Peiter; Góes, 2022). The United States was also the main destination for products from Brazil's Mineral Processing Industry at the end of 2024, accounting for 26.1% of Brazilian exports, equivalent to USD FOB 2.17 billion (ANM, 2024).

The European Union was the third-largest destination for Brazilian mineral exports, totaling US$2.87 billion, followed by Canada (US$2.30 billion) and Malaysia (US$1.91 billion), as shown in Figure 2. In the specific case of the European Union, the bloc stands out for

the diversity of its public policies concerning critical raw materials, owing to its historical economic growth and the limited availability of domestic reserves of metallic minerals (EC, 2008 *apud* Castro; Peiter; Góes, 2022). Thus, China, the United States, the European Union, Canada, and Malaysia, as major purchasers of mineral commodities extracted in Brazil, would constitute preferred countries in negotiation processes due to their bargaining power.

Finally, in another specific geopolitical situation involving an armed conflict, namely the Russia-Ukraine war, the United States reportedly conditioned its support for Ukraine on access to and the purchase of the country's rare earth elements (Miller, 2025), which would characterize strong diplomatic and economic bargaining in the negotiation process.

Regarding Porter's fourth Competitive Force, the **threat of substitute products,** Rare Earth Elements deserve particular attention within the universe of Strategic and Critical Minerals. This group comprises 17 chemical elements that constitute a foundation for future technologies. Owing to their optical, magnetic, and electronic properties, these mineral commodities are considered irreplaceable in numerous modern applications, including electric vehicles, wind turbines, medical and hospital equipment, and the production of high-value-added technological products (Oliveira et al., 2025; Júnior; Oliveira, 2020 *apud* Santos, 2025).

Currently, the demand for Rare Earth Elements has intensified due to the growing need for high-purity metals and oxides used in the production of high-technology goods (Loureiro, 1994 *apud* Souza et al., 2019). The versatility of each element is associated with its magnetic properties, which are essential for permanent magnets

used in electric vehicles and wind turbines; luminescent properties, which are applied in LED displays; catalytic properties, which are employed in automotive converters; and electrochemical properties, which are relevant to rechargeable batteries (Souza Filho; Barreto, 2019 *apud* Santos, 2025).

Thus, the use of these materials is not merely quantitative but also qualitative, given that their physicochemical properties are considered irreplaceable, ensuring the performance, durability, and efficiency of manufactured products. Consequently, they have become key components of energy security, industrial competitiveness, and the technological sovereignty of countries (Karas, 2025).

In electronics, Rare Earth Elements are indispensable for smartphones, computers, televisions, medical equipment, and optical fibers. Their importance derives from unique physicochemical properties that enable the production of materials for which viable substitutes are limited or unavailable (IEA, 2023; UNCTAD, 2023 *apud* Santos, 2025). In biological systems, these elements have been extensively studied because of their exceptional spectroscopic and magnetic properties, which are useful in biomolecular research, particularly involving proteins that bind to calcium (Martins; Isolani, 2005). Biological tracers are also noteworthy for monitoring the pathways followed by drugs in humans and animals, including fluoroimmunoassays (CGEE, 2013).

Therefore, even in the absence of mineral substitutes or alternatives for Rare Earth Elements, as new deposits are discovered and these mineral commodities are incorporated into value chains for commercial purposes and industrial and technological processes,

the countries possessing them increasingly enter a select group of holders of Strategic and Critical Minerals. This may strengthen their position, relative to other countries, as major suppliers and competitive participants in the global market.

Finally, regarding Porter's fifth Competitive Force, the **threat of new entrants,** the barriers that hinder the entry of new rare earth producers into the global market include high capital costs, exceeding US$30,000 per ton; the high costs of the technologies required for each type of mineral; the fact that few companies outside China possess the technology necessary for rare earth exploration; and China's dominant position in the market, supported by relatively lower mining costs (Korinek; Kim, 2010 *apud* Reis Melo, 2017).

To avoid external dependence on the importation of critical minerals required by its domestic industry, Brazil will prioritize, through the National Strategy for Science, Technology and Innovation, the development of strategic technologies aimed at strengthening the integration between science and industry. In this context, the country would foster integrated value chains for critical minerals through their exploration, processing, and recycling, thereby reducing vulnerabilities and promoting mineral sustainability (Brasil, 2024b).

At the same time, industrialized countries, including the United States, the European Union, and Japan, have expressed concern about the possibility of restricted access to certain raw materials, including Rare Earth Elements, whose reduced supply could have significant implications for the functioning of their economies. Increased competition resulting from globalization has encouraged

some countries to implement industrial and trade development strategies through measures designed to reserve their resources for domestic use (Reis Melo, 2017).

Not coincidentally, in order to reduce the barriers imposed by China and secure mineral supplies, including access to mineral resources, in April 2026 the U.S. company *USA Rare Earth* announced the acquisition of the Serra Verde mining company, located in the state of Goiás, for US$2.8 billion (R$14 billion). This mining company was the only one in Brazil producing heavy rare earth elements (HREE) on a large scale, such as dysprosium and terbium, which are used in high-performance magnets and advanced technologies. The transaction was intended to establish a platform for securing the global supply of rare earth elements to the United States over the coming decades (Ferrari, 2026).

In summary, as a result of this global context, many countries are seeking to invest in exploration projects, including the United States, Canada, Australia, and Denmark (Greenland). The challenges are considerable. Because rare earth mining is a difficult and costly operation, ensuring an adequate return on investment would require integrating mining activities into the broader production chain; otherwise, there may be insufficient demand for the resulting products (Brasil, 2013).

Finally, it can be partially concluded that the analysis of Porter's Five Competitive Forces within the international landscape of Strategic and Critical Minerals is feasible insofar as it provides a comprehensive understanding of countries' competitiveness in the mineral sector. Based on the resulting conclusions, strategies could be developed to support the repositioning of these countries,

enabling them to establish competitive differentiation in the management of these mineral commodities at an important and decisive moment when disruptive technologies are increasingly necessary to address the challenges of the twenty-first century.

3. METHODOLOGY

The approach adopted in this research was qualitative in nature, as its primary objective was to analyze the global landscape of Strategic and Critical Minerals from the perspective of Michael Eugene Porter's Five Competitive Forces. This approach is widely recognized in the scientific literature for its capacity to support contextual analyses, thereby facilitating an understanding of the benefits associated with the appropriate and effective application of Michael Eugene Porter's strategic management framework to Strategic and Critical Minerals in the current global context. Furthermore, qualitative research focuses on the interpretation and understanding of complex phenomena and is particularly relevant to fields characterized by dynamic, complex, and geopolitical environments, such as mineral commodities used across a wide range of economic and technological activities.

With regard to the methodological procedures, the research was classified as bibliographic. This type of procedure is based on the systematic examination of previously published scientific literature, constituting one of the foundations of scientific knowledge construction. According to Pereira et al. (2018), bibliographic research contributes to the consolidation of theoretical and methodological frameworks by bringing together and interpreting significant contributions related to a specific subject. Yin (2016) further argues that this approach strengthens the analytical

robustness of research by grounding discussions in established theoretical perspectives.

For the purposes of this review, the research sources were selected and classified into two categories: (1) sources presenting definitions and explanations of Porter's Five Competitive Forces; and (2) sources assessing the international landscape of Strategic and Critical Minerals in light of Porter's principles, particularly with regard to these mineral resources and their growing importance in the twenty-first century.

The classification of these sources provided a broader understanding of the feasibility of applying Michael Porter's framework to support the strategic positioning of Strategic and Critical Mineral-related businesses in the international arena. The bibliographic and documentary reviews were conducted using national and international publications, scientific articles, Brazilian government agencies, international organizations, multinational institutions, and Internet-based sources, thereby ensuring a broad knowledge base capable of reflecting the possibilities for assessing the competitiveness of businesses associated with Strategic and Critical Minerals.

4. FINAL CONSIDERATIONS

The rapid economic and scientific-technological transformations occurring during the first half of the twenty-first century have intensified the consumption of mineral resources destined for a wide range of production chains. This international demand, in turn, has placed international relations among countries and global

supply logistics under increasing pressure as a result of the commercialization of these mineral commodities.

At the same time, global warming and climate change have prompted the international community to initiate an energy transition process, with the gradual reduction of dependence on fossil fuels as one of its consequences. This process has been associated with the pursuit of a more sustainable model of development.

Under the two circumstances described above, the solutions identified involve inputs whose production and industrial processing depend on Strategic and Critical Minerals. Against this backdrop, the international mineral landscape has become increasingly contested, characterized by a more competitive global market.

Considering these conditions, strategic planning could rely on a management tool that has contributed significantly to providing greater clarity in business decision-making, particularly in contexts involving high-technology machinery and equipment, substantial investments, and products with recognized added value.

Accordingly, the research identified numerous situations that were conceptually framed within Porter's principles, providing a broad understanding of how a management model could facilitate the conduct of international business, reposition productive activities, and foster their competitiveness in the international market.

Thus, this article aimed to analyze the global landscape of Strategic and Critical Minerals from the perspective of Michael Eugene Porter's Five Competitive Forces. Based on this analysis, it also sought to provide political, economic, and scientific-technological

institutions with insights that could contribute to a comprehensive understanding of the competitiveness and positioning of the mineral sector in the face of the challenging and complex scenarios emerging in the twenty-first century.

The research appears to have achieved its objectives by providing a series of insights that could potentially inform the decisions of senior managers in public institutions, as well as business and industrial leaders, regarding opportunities for the economic, industrial, and technological exploitation of mineral resources with specific strategic classifications.

It is noteworthy that a strategic business tool developed during the second half of the twentieth century may still provide analytical support for issues that have become increasingly prominent in the twenty-first century. In this regard, the research addressed the question: “How can a management tool be used to assess the international landscape of Strategic and Critical Minerals in a context in which these resources have become indispensable to economic and technological development in the twenty-first century?” The analysis developed throughout this research provided an answer to this question.

Furthermore, the qualitative approach, through a literature review and documentary analysis, was fundamental in demonstrating the continued applicability of Porter’s Five Competitive Forces to the assessment of the global landscape of mineral commodities, to the extent that the framework can provide insights for companies, industries, and countries seeking to reposition these resources and strengthen their competitiveness within the current economic, industrial, and scientific-technological environment.

Finally, future research could consider examining the interrelationship between the concepts and definitions associated with Liberal Theory in International Relations and the current foreign policies adopted by countries concerning Strategic and Critical Minerals.

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