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Articles

Capital hits bottom: deep-sea mining representations as a resource frontier

El capital toca fondo: representaciones de la minería en aguas profundas como frontera de recursos

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Abstract

This article aims to analyze the central discourses present in narratives about deep-sea mining, to understand what representations are being constituted of the ocean floor and its minerals. With a methodology based on qualitative content analysis applied to grey literature, including media and social networks published in the period from June 2021 to June 2024, the results show that the themes of blue economy, governance and biodiversity are connected to resource frontier dynamics such as the need to exploit other sources, govern resources and present the ocean floor as a zone of opportunity. Although it is recognized that some issues may be missing, the sample illustrates the characteristics of the most dominant and recurrent positions on deep-sea mining. These findings allow to nurture the conceptual discussion and open questions about the creation of new extraction spaces at a global level.

Keywords: deep-sea mining, resource frontier, representations, capital.

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Resumen

Este artículo tiene como objetivo analizar los discursos centrales presentes en narrativas sobre la minería en aguas profundas, para comprender qué representaciones se están constituyendo del fondo del océano y sus minerales. Con una metodología basada en el análisis cualitativo de contenido aplicado a literatura gris, incluidos medios de comunicación y redes sociales publicados en el periodo de junio de 2021 a junio de 2024, los resultados muestran que los temas sobre economía azul, gobernanza y biodiversidad se conectan con dinámicas de la frontera de recursos como la necesidad de explotar otras fuentes, gobernar los recursos y presentar al fondo del océano como una zona de oportunidad. Se reconoce que pueden faltar algunas temáticas, la muestra

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ilustra las características de las posiciones más dominantes y recurrentes sobre minería en aguas profundas. Estos hallazgos permiten nutrir la discusión conceptual y abrir interrogantes sobre la creación de nuevos espacios de extracción a nivel global.

Palabras clave: minería en aguas profundas, frontera de recursos, representaciones, capital.

Introduction

In the context of the transition to low-carbon technologies, recent research shows that replacing fossil fuels with renewable energies has dramatically increased demand for critical minerals used in electronics, electric vehicles, energy storage, wind turbines and solar photovoltaics (Agusdinata & Liu, 2023).

This process has led to the so-called *mineral era*, characterized by the growing diversity and quantity of metals and minerals required to sustain contemporary transportation systems and livelihoods (Muñoz Sueiro, 2021). In this context, capital has promoted a discourse focused on the scarcity and inaccessibility of these minerals without the use of appropriate technologies, thereby promoting the need to explore new territories potentially rich in deposits (Zalik, 2018).

Under this logic of extractive expansion, the mining industry has turned its attention to the seabed, where large reserves of minerals considered strategic for the energy transition can be found (Koschinsky et al., 2018). As such, minerals from the ocean depths have been reconfigured as essential resources for consolidating the energy transition and meeting sustainable development goals (Hyman et al., 2022; Miller et al., 2021).

Nevertheless, this promise of sustainability has been increasingly questioned. Various studies warn of the ecological, technological and ethical uncertainties of deep-sea mining and raise doubts about its viability for a sustainable future (Hallgren & Hansson, 2021). Faced with this criticism, the industry promotes the idea of responsible mining that is compatible with climate change mitigation (Le Billon, 2021).

This debate assumes particular relevance when considering the challenges that the ocean floor presents to human experience. The way the deep sea and its minerals are represented is a critical question for understanding how deep-sea mining is legitimized. A key precedent in this regard is the failed Solwara 1 project in Papua New Guinea, promoted by Nautilus Minerals between 2011 and 2019. Its cancellation was due to both financial difficulties and strong opposition from local communities, non-governmental organizations and States in the Pacific (Childs, 2019; Van Putten et al., 2023).

Attempting to build social acceptance, the company developed three arguments: *a*) the dynamism of the deep sea, presenting it as a manageable and controllable space; *b*) the spatial and temporal limitations of the procedure, minimizing its impacts; and *c*) the remoteness of the deep ocean, represented as a place of no significance and without direct human impact (Childs, 2019).

Despite the prominence of natural sciences, engineering and technological development in the study of deep-sea mining, social sciences have begun to problematize

how representations of the deep ocean, its spatial and temporal factors, as well as its material and symbolic interconnections are constructed (Carver, 2019; Childs, 2019; Deberdt & James, 2024; Gentilucci, 2022; Hine et al., 2024; Levi & Peters, 2024; Sammler & House-Peters, 2023; Whittaker et al., 2024; Zaar, 2024). This work is part of that critical line of inquiry to investigate how the ocean floor and its minerals are represented in the face of the emergence of this new extractive frontier.

Within the literature that has addressed the discussion on natural resources, peripheries and frontiers, these spaces are presented as either empty or endowed with resources that are distant from economic-urban centers (Hayter et al., 2003; Rehner et al., 2020; Rehner & Rodríguez, 2018, 2021; Serje de la Ossa, 2017). As such, frontiers are seen as areas of extraction and production where territorial disputes, institutional regulations and various forms of violence converge (Cons & Eilenberg, 2019; Tsing, 2003). Within this framework, the territorial transformations that enable resource exploitation have been conceptualized as resource frontiers and commodity frontiers (Silva & Sareen, 2023), terms that are often used interchangeably to describe processes of incorporating raw materials into global capitalist expansion (Kröger & Nygren, 2020; Moore, 2015), including areas with future extractive potential (Kemp & Owen, 2024).

Although this approach was initially applied to land use changes, its extrapolation to new spaces such as the ocean and outer space has been progressively adopted (Carver, 2019). Nonetheless, studies on the configuration of extractive frontiers in the ocean, and especially on deep-sea mining, remain scarce (Childs, 2019; Fache et al., 2021; Filer et al., 2021; Kung et al., 2021; Rodríguez Leiva, 2024). This paper seeks to contribute to this emerging agenda by analyzing the discourses shaped around deep-sea mining, intending to understand what representations are being constructed of the ocean floor and its minerals.

To address these questions, a methodology based on qualitative content analysis applied to gray literature, including media and social networks, is proposed. This source is considered particularly relevant, as it offers an abundant and dynamic corpus of public discourse on underwater mining, thus providing a rich and largely unexplored basis for critical analysis.

This article is divided into six sections. After the introductory section, the second section presents the theoretical framework. The third section describes the methodology and reports on the methods and materials used in this work. The fourth section presents the main results. The fifth section discusses these results in terms of the theoretical and conceptual approaches presented in the introduction. Finally, the sixth section presents the conclusions.

Theoretical framework

The discussion on resource frontiers

Academic publications on regions rich in natural resources have tended to neglect the analysis of the periphery and the frontier, often conceived as remote and empty spaces available for exploitation (Hayter et al., 2003; Rehner et al., 2020; Rehner & Rodríguez, 2018, 2021). Frontiers, understood as places of extraction and production,

are shaped by territorial disputes, institutional regulations and forms of violence (Cons & Eilenberg, 2019; Tsing, 2003). Their transformation has been addressed through the concepts of resource frontier and commodity frontier (Silva & Sareen, 2023), often used interchangeably (Kröger & Nygren, 2020) to describe processes of incorporating raw materials into global capitalist expansion (Moore, 2015), which includes areas not yet exploited (Kemp & Owen, 2024).

Work by Tsing (2003) suggests that the resource frontier corresponds to that edge of space and time where nature appears inert, ready to be dismembered and packaged for export (Tsing, 2003). The resource frontier is intrinsically linked to both space and time as an integral part of the process of spatial transformation (Frederiksen & Himley, 2020) and to the expansion of capital and technological growth, where technological advances in mineral extraction have allowed new spaces to be considered resource frontiers (Barlow, 2023).

Recent studies have problematized the concept of resource frontiers and show how these spaces are characterized by an abundance of land and resources (Barbier, 2007); as relational zones of economy, nature and society (Barney, 2009); and as empty space. A key element in these works has been that these spaces are perceived as zones of capitalist transition.

In this regard, Moore (2015) points out that capital develops strategies to carry out processes of appropriation, accumulation and transformation, which translates first into the creation of the resource frontier and subsequently into its transformation into a frontier of commodities or cheap goods (Banoub et al., 2021).

In this context, various studies have provided valuable insights into the resource frontier, specifically those referring to the processes behind its creation and the role of various actors and forces that reinvent these spaces as areas of economic opportunity (Cons & Eilenberg, 2019); the characteristics of nature's socio-metabolism and commodification processes that transform nature (Irarrázaval & Bustos, 2019); and the configuration of multidirectional and multiscale relations formed by various human and non-human agents (Beban & Banks, 2023).

The work of Banoub et al. (2021) is inspiring. It proposes the need to address the multiplicity of ways in which socio-ecological processes are appropriated and internalized into the dynamics of capital expansion and accumulation at the resource frontier; how to delve deeper into the spatial, temporal and material characteristics of resources; and how they particularly affect the process of capital expansion into new spaces.

Deep-sea mining and the resource frontier

Literature linking the discussion on resource frontiers to the ocean, and in particular to deep-sea mining, has increased in recent years and generated interest in different areas such as social sciences, arts and humanities (Childs, 2020).

Although the key approaches to the resource frontier were designed for land surfaces, recent studies propose that the ocean is becoming an emerging resource frontier and show processes of reorganization and expansion of capitalist value relations in the oceans at the global level (Carver, 2019). At this point, a key role is played by the so-called blue economy, a paradigm that refers to the simultaneous capacity to promote economic growth and foster sustainable practices (Chen et al., 2023).

This spatial reworking of the ocean as a new frontier has been widely questioned, notably by Silver et al. (2015), who highlight the discourses of natural capital and good business associated with the blue economy and how another layer of thinking and imagining the ocean has been added (Rozwadowski, 2005). From representing the ocean as an elusive, dangerous and unknown place, it is now seen as a space that could help humanity in its quest to promote economic growth, but in a way that is friendly to the marine environment and the diverse ecosystems that comprise it (Bennett et al., 2021; Childs, 2020; Satizábal et al., 2020).

Deep-sea mining has become a key topic in discussions aimed at understanding this branch of mining as a resource frontier. Various studies critically analyze the proposed associations between economic growth, the achievement of sustainable development goals and sustainable alternatives to land-based mining (Childs, 2019; Fache et al., 2021; Kung et al., 2021; Novaglio et al., 2022). Along these lines, based on the work of Wong et al. (2022) and the analysis of the dynamics underlying the creation of resource frontiers, Rodríguez Leiva (2024) finds that the dominant narratives surrounding deep-sea mining as a resource frontier are the governance and regulation of seabed minerals, biodiversity and the implementation of standards and the blue economy and its connection to the energy transition.

Nevertheless, although these studies have enriched the discussion, it is unclear how these processes of capital expansion connect with other agencies at the resource frontier. In this regard, the work of Banoub et al. (2021) is enlightening and proactive in terms of how to address this issue, formulating the time-space-form framework to analyze spatial and temporal extensions and materiality in the process of capital expansion and accumulation in the transformation of nature. This points to a more sensitive understanding of other agencies that seek to highlight human interactions with minerals, how these vary over time and space and, finally, how materiality is actively reconstituted as a result of the power relations between multiple actors (Banoub et al., 2021; Chagani, 2014; Srinivasan & Kasturirangan, 2016).

Oceanic materiality and deep-sea mining

Various studies have shown how the ocean floor, in its extreme location, escapes human senses, making it important to analyze natural environments that are experienced in different ways (Escobar, 2017; Hine et al., 2024; Li, 2015). In this regard, Steinberg (2013) suggests that the ocean floor should be recognized as a collection of living

worlds, as a space that is more than a static means of connection between places, but rather an actor with political agency (Lehman, 2013), a place composed of multiple places, and also one that is formed concerning more than human actors (Peters & Steinberg, 2019).

Furthermore, Steinberg (2001) has proposed that the ocean is socially constructed in various ways, with human perceptions being shaped over time. Discursive construction about the ocean has seen growing interest in recent years, addressing a variety of perspectives that emphasize the role of history, politics, culture and society (Childs, 2019). Thus, the ocean is presented as a material and discursive geopolitical agent, with spatial and temporal dimensions that strain the forms of access and control of mining resources (Childs, 2022).

Continuing this line of thought, Steinberg and Peters (2015) state that the ocean should no longer be viewed as a static or inert factor in politics; rather, seas and oceans should be seen as vibrant, fluid and material political actors. This is closely related to Bennett's (2022) questioning of the idea that matter is passive, rough, crude or inert. The author calls for consideration of the vitality of matter and its capacity as an agent of transformation, where living realities coexist that reject the separation of the human and the non-human, or the organic and the inorganic.

In this line of thought, the relation between the seabed and both organic and inorganic matter is proposed. Povinelli (2016) discusses how the ocean floor is transformed into a political space of life and non-life, becoming a space of life and death.

Moreover, it is proposed that the ocean floor should be considered not only as a volume, but also as a depth (Deloughrey, 2017). Considering this depth means paying attention to the physical properties of deep-sea materials, as well as their social construction shaped by particular practices, technologies and discourses (Hannigan, 2016). In short, for Deloughrey (2017), deep-sea mining can be interpreted as an existence composed of emerging and evolving parts that come together to define it at a given moment in time.

To complement this, Childs (2020) suggests that the ocean floor and its minerals are not under water but rather submerged in it. This idea proposes the conception of the ocean floor as a porous space through which water flows and is constantly constituted over time. This has been linked to approaches that attempt to inform about the vitality of the ocean floor and how, in this dynamic process, minerals become resources through the combination of social forces based on present and future needs that certain human actors possess; and geological materials and processes with specific timelines that differ from human time, where non-human agencies acquire relevance in the constitution of the ocean floor and its minerals (Bakker & Bridge, 2006).

Methodology

The methodology proposed in this work is based on qualitative content analysis, which explores the predominant discourses on a particular topic. This methodological approach does not aim to cover all aspects of a given topic (Demiris et al., 2020), but rather to capture the breadth of a debate and provide key points of view and positions.

This process allows for the strategic selection of both symbolic and material elements of the subject under study, which are grouped discursively into narratives that enable an understanding of social processes that construct representations of a space and its possible futures (Pierce et al., 2011). Thus, partial and sometimes imaginary or ideal representations of a space are the attributions, identities, knowledge, discourses and other symbolic factors that agents use as strategic devices to promote social and political objectives (Weller, 2019).

In this case, qualitative content analysis focuses on identifying key discourses on deep-sea mining. To this end, the first step was to develop a *search strategy*. In particular, information from gray literature was used, that is, media and social networks, such as posts on X (formerly Twitter), Instagram and LinkedIn, which deal with deep-sea mining. This decision is justified by the fact that gray literature on aspects of deep-sea mining provides a rich and untapped source of information available for analysis.

The term *minería en aguas profundas* (deep-sea mining) was searched for in Spanish between June 2021 and June 2024.

The period was determined because, since June 2021, the conflict surrounding the start of deep-sea mining has gained greater global attention in the media and social media posts, as in that month the government of Nauru informed the International Seabed Authority (ISA) of its intention to exploit the seabed in the Clarion-Clipperton Zone, an area of the North Pacific between Hawaii and Mexico (International Seabed Authority, 2023).

This development falls under the two-year rule established by the United Nations (UN), which stipulates that if, after this period, the ISA does not have regulations in place, Nauru, through Nauru Ocean Resources Inc., a subsidiary of The Metals Company (formerly known as DeepGreenMetals), may begin mining the seabed in international waters.

Thus, in Google search, using the combination of words *minería en aguas profundas* (deep-sea mining), a total of 480 results were found, 151 of which corresponded to the period analyzed. On the LinkedIn platform, 57 results were found, on Instagram, a total of 25 results with the search #*mineríaenaguasprofundas* (#deepseamining), and finally, on X (formerly Twitter), a total of 367 posts were found.

With this information, the second step consisted of identification and coding based on an inductive approach, followed by a third step of analyzing the discussions and arguments that enabled the construction of narratives. Subsequently, the dominant themes were discussed through the conceptual lens of the categories proposed by Banoub et al. (2021) to understand the resource frontier, which refer to time, space and matter. This process was carried out through a deductive approach based on key academic discourse literature.

Finally, it should be noted that this research may lack some topics related to deep-sea mining. Notwithstanding, the sample analyzed makes it possible to illustrate the characteristics of the predominant and recurring positions on deep-sea mining. Furthermore, it is important to note that a source of information, such as a media article or social media post, may contain more than one narrative, so the aim was not to indicate which narrative each source of information leans toward, but rather, in the general review, how the key argument presented in it is constructed.

Results

The key narratives present in the discourses identified in the gray literature on deep-sea mining cover three themes: blue economy, governance and biodiversity. Each of these has sub-themes that, combined, communicate representations of deep-sea mining. The key aspects that constitute them are detailed below.

Blue economy: energy transition, decarbonization and critical minerals

The position on the blue economy focuses mainly on addressing how the transition from fossil fuels to the use of low-carbon energies —considered clean and green in the context of climate change— represents a path that is related in multiple dimensions to mineral extraction. In this regard, the extraction of minerals, currently considered critical and found in large quantities deposited on the seabed, would enable the development of technology through their use in batteries for electric vehicles, wind turbines and solar panels.

Regarding the association of this position with processes underlying the creation of resource frontiers, it is possible to observe that the ocean floor is presented as a new frontier for a green economy in a blue world. In particular, arguments are presented regarding how the extraction of minerals from the ocean floor is a key driver of economic growth, the achievement of sustainable development goals and a sustainable alternative to land-based mining. This vision is closely related to the need to present the ocean and its minerals not only as a new source of resources that needs to be exploited, but also as an area of opportunity, where exploitation can be developed and development is unlimited (Wong et al., 2022).

Governance: national security, technological development and economic dependence

The governance perspective addresses issues such as national security, development, technological innovation and, finally, aspects related to economic dependence.

Regarding national security, two issues have been identified: the legal development of deep-sea mining and the lack of regulation of this activity. This concerns the expansion experienced in recent years by industries such as industrial fishing and the fact that, with the possible start of deep-sea mining, the oceans and their ecosystems could be affected by the lack of clear regulation and measures aimed at protecting ecosystems. It also highlights aspects that relate national sovereignty to governance strategies and mechanisms that refer to geopolitics in the oceans and how countries can develop guidelines to not only protect sovereign areas but also allow progress toward objectives set out in the framework of the transition to green energy.

Related to technological development and innovation, there are elements associated with automation and robotics in mining operations. Innovations in mineral extraction processes are presented as safer and more efficient options to promote industry responsibility in the extraction, transport and processing of minerals extracted from the ocean floor.

Regarding economic dependence, which is a big part of the deep-sea mining conversation, there are two key points for discussion. In the first, there is extensive debate regarding the role of the ISA in controlling exploration, possible exploitation and equitable distribution of the benefits derived from the exploitation of resources (Hallgren & Hansson, 2021). In the second, there is growing mention of China's role in the process of exploration and eventual exploitation of minerals from the ocean floor. Due to China's extensive control over global reserves of critical minerals, it has become important to access the ocean floor as a mechanism for controlling these resources and preventing the expansion of China's coverage. In response to this, countries such as Norway decided in January 2024 to begin exploiting the seabed as a way to escape dependence on China and its dominance in the control and use of mineral resources.

Concerning the processes underlying the creation of resource frontiers, the ocean floor is presented as a space that needs to be governed so that rules can be established and its resources controlled (Wong et al., 2022). The mechanisms used to regulate the ocean, and in particular the mineral resources located on the ocean floor, involve the development of strategies based on the control of areas that, until now, have been rich in resources through the granting of exploration permits and, shortly, exploitation permits.

Biodiversity: conservation and ecological damage

The main focus of this perspective is the biodiversity and environmental impact of deep-sea mining. Specifically, it discusses *1*) how damage to the geodiversity of the ocean floor could be irreversible, as well as the impacts on biological and environmental diversity and on the ecosystem services of the ocean; and, *2*) aspects related to the need for species conservation, and how clean technologies would allow for greater protection and conservation of various marine species, although no points are identified that address this in detail, so it is unknown what mechanisms and strategies it would be feasible to implement in this area. The latter is associated with isolated positions that highlight the association between green technologies and environmental damage, thereby questioning the idea that the development of new low-carbon technologies would help protect fragile marine ecosystems.

The correlation between this issue and the processes underlying the creation of resource frontiers is relatively similar to the previous one, particularly in terms of the need to govern and create regulations or norms that enable control of this space, but through the protection of marine ecosystems and species conservation.

Discussion

Using the analytical categories proposed by Banoub et al. (2021) concerning space, time and matter, this section seeks to discuss the prevailing positions that constitute representations of deep-sea mining.

Space

The prevailing discourses on the blue economy, governance and biodiversity have approaches that are related to space. The ocean floor and its minerals are often portrayed as a dark and unknown space, located in the depths of the sea, but which, despite this, is presented as a mineral-rich area that is currently being discovered. Accordingly, and within the framework of governance perspectives, the ocean floor is viewed as a vast and unknown space.

Such conceptions of space are closely related to Barbier's (2007) argument that the ocean floor and its minerals represent a resource frontier with abundant land and minerals, offering ample opportunity for economic development (Cons & Eilenberg, 2019).

Likewise, the concept of space can be linked to the blue economy, where deep-sea mining has taken on a key role. In this regard, it is established that the ocean floor as an area of opportunity is closely related to the objective of the blue economy (Carver, 2019) in that it simultaneously seeks to promote economic growth and encourage sustainable practices (Childs, 2019).

Time

The understanding of minerals at the bottom of the ocean, and in particular the polymetallic nodules[1] that are deposited there, has a different timeframe than the time that permeates 21st-century society, as well as the time that is expected to connect these metals with their functionality in the context of economic growth and technological development.

It is estimated that a polymetallic nodule takes up to a million years to grow a few millimeters. In addition, they are a key part of the marine ecosystem in which they are found. Once these ecosystems are destroyed, the species that inhabit them take years to rebuild them. As such, the massive and long-term damage to nature has begun to be proposed as ecocide. This timeframe differs from the projections made for the use of these minerals. The United States Geological Survey estimated that by 2065, about one-third of critical metals would come from deep-sea mining (Hunt, 2024).

[1] Polymetallic nodules are a type of mineral deposit found on the ocean floor, at depths of 3 000 meters to 6 000 meters. They are rocks ranging from 5 mm to 10 cm in diameter, composed of manganese, iron, cobalt, copper, nickel, rare earth elements and other minerals. To date, the highest concentration of polymetallic nodules has been found in the Clarion-Clipperton Zone, an area off the west coast of Mexico.

For Miller et al. (2021), the latter is related to the current and future needs perceived in society and established as a necessity that must be met, in this case, within the framework of the transition to low-carbon energies and sustainable development goals (Hyman et al., 2022). This is related to the findings of Peters and Steinberg (2019) and Childs (2020), in which the ocean floor is presented as a space that is constantly being constituted over time.

The temporal characteristics of the ocean floor and its minerals pose a challenge to the process of capital accumulation, as suggested by Moore (2015) and Banoub et al. (2021), since it is unclear how the mining industry can address the spatial and temporal dimensions of the ocean (Childs, 2022).

Materiality

There are two opposing positions on how to approach the materiality of deep-sea mining. First, it is established that minerals on the ocean floor are rocks that can be viewed as electric batteries, given the amount of minerals they contain and their usefulness in the construction of these key components for electromobility. At this point, the possible scenario of a battle to obtain them is suggested, positioning minerals as marine treasures, where the material is understood as something inert and purely functional for society and as a product that would enable the construction of technologies in the context of the transition to low-carbon energies. Furthermore, the dispute over the acquisition of these rocks is referred to as an element associated with sovereignty and control of resources (Childs, 2020), as well as establishing this space as an area of opportunity for development (Wong et al., 2022).

Second, there are elements that, to a lesser extent, relate to conceiving the ocean floor as a living, moving space. Crucial here is the idea of the vitality of matter (Bennet, 2022), in terms of how the ocean floor is formed over time and by a combination of various geological processes that, upon contact with water, shape the minerals in question. This is also related to the arguments of Steinberg (2013) and Peters and Steinberg (2019) regarding the conception of the ocean floor as a site composed of multiple places that shape a political, vibrant, fluid and material space.

Conclusions

Based on the results presented and the discussion developed, it is possible to conclude that crucial and predominant themes on deep-sea mining are identified in the gray literature, which are related to positions on the blue economy, governance and biodiversity. In general, these themes are associated with processes underlying the creation of resource frontiers described in the literature, related to the need to exploit other sources of resources, to govern, regulate and control resources, and to present the ocean as an area of opportunity and also as a possibility for unlimited exploitation.

Both the prevailing narratives and their connection with the processes underlying the creation of resource frontiers provide answers to research questions about which topics are gaining prominence in gray literature, and also how they are combining with processes of capital expansion into new spaces, under the conceptual approach of the resource frontier. These findings not only enrich the conceptual discussion on resource frontiers but also raise questions about the dynamics behind the process of capital creation in new spaces, in this case, at the bottom of the ocean. Moreover, the call is for future research to further problematize these current dynamics, not only contributing to the existing theoretical-conceptual construction but also challenging and adding new approaches to the understanding of spaces such as the seabed.

Another relevant point concerns how the discussion surrounding the categories of space, time and materiality could pose a problem in the process of creating resource boundaries. The physical, spatial, temporal and material characteristics of the ocean floor could represent valuable input for understanding the marine environment in which the industry would operate. To this end, the call is not only to the mining industry but also to the production of specific knowledge on this subject. Although this work joins other recent research that discusses deep-sea mining as a resource frontier, it is necessary to broaden the debate to include the processes of representation of the seabed in the context of emerging extractive industries.

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