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Space Mining and the Legal Frontiers of Imperialism: A Postcolonial Critique Using the Novel Dune

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ABSTRACT: This paper analyzes how science fiction, using Frank Herbert's *Dune* as a case study, reflects on and critiques the imperialist and neo-extractivist ideologies underpinning emerging space governance. Drawing on postcolonial theory and TWAIL, it examines how narratives of colonial conquest, resource extraction, and resistance in fiction mirror real-world space policies. Dune's "spice" serves as an analogy for resource plunder and geopolitical dominance within contemporary debates on space neo-extractivism. The study argues that treaties like the Artemis Accords and private space mining ventures risk perpetuating historical patterns of economic and political subjugation, favoring technologically advanced nations and corporations. By integrating dialectical literary analysis with TWAIL and Marxism, the paper reveals the ideological underpinnings of international space law and questions its potential to replicate Earth's colonial past. The findings underscore the urgent need for interdisciplinary dialogue to ensure equitable and just space exploration, preventing it from becoming another frontier for imperial expansion and resource-driven inequalities.

KEYWORDS: neo-extractivism, space mining, colonialism and imperialism, third world approaches to international law (TWAIL), dune (1965).

I. INTRODUCTION

The climate crisis and biodiversity loss directly result from unchecked resource exploitation, pushing humanity toward an unprecedented existential threat driven by extreme natural events. Scholars argue that these environmental shifts are not accidental but the result of economic systems prioritizing profit over sustainability. Rooted in capitalist expansion, these structures continuously extract and deplete natural resources while devising temporary solutions that maintain their growth, a paradox the Frankfurt School describes as irrational rationality (Horkheimer & Adorno, 2007; Marcuse & Kellner, 2012).

The contradiction between capitalism's relentless expansion and Earth's ecological limits has propelled space exploration from a fictional fantasy into reality. Scholars see this shift as another extension of imperialism and colonial thinking, shaping modern economic and political systems. The Bretton Woods framework, which built the global financial system, prioritizes perpetual economic growth while imposing neoliberal constraints on developing nations, often ignoring local realities and worsening environmental damage (Surhone et al., 2010). Recent advancements in space technology reinforce these patterns, such as private space enterprises like SpaceX and Blue Origin, which are driving a new race for control of extraterrestrial resources, raising concerns about space governance, environmental ethics, and economic inequality.

The interplay between cultural production, imperialism, and colonialism is well-documented in the humanities and social sciences (Said, 1994). Science fiction, long viewed as an arena for futuristic speculation, also reflects and reinforces dominant ideologies. Many narratives embed capitalist and colonialist structures into their depictions of space colonization, presenting exploration as an inevitable human endeavor. This relationship is visible in how spacefaring protagonists, from Flash Gordon to Captain James T. Kirk, embody

heroic ideals of conquest and discovery, reinforcing cultural values that parallel historical patterns of imperial expansion (Althusser, 2014).[i]

Beyond its entertainment value, science fiction offers a symbolic lens to examine power structures, technological expansion, and environmental concerns. These narratives critically reflect historical legacies and contemporary global politics (Banerjee, 2022; Martins Simoneti, 2022; Ashcroft, 2020). However, one area of postcolonial science fiction studies that remains largely unexplored is the international legal framework governing space exploration and exploitation.

Given that international law has historically legitimized imperial ventures, this paper aligns with the assertion made by Mutua and Anghie (2000, p.31) that the "[…] regime of international law is illegitimate. It is a predatory system that legitimizes, reproduces, and sustains the plunder and subordination of the Third World by the West." Science fiction serves as a repository of ideological narratives (the "supply of knowledge," according to Gernsback, 2016, p. 16), preserving the mindset of its time while projecting those ideas into the future. This study integrates postcolonial science fiction (SF) analysis with Third World Approaches to International Law (TWAIL) to identify how imperialist logic is embedded in international space law (Hoagland & Sarwal, 2010).

Frank Herbert's Dune (1965) provides the theoretical and empirical markers for our study, offering a literary critique of colonialism, extractivism, and environmental destructi[iiii] The narrative is set on the desert planet of Arrakis, where imperial struggles over the spice (mélange) unfold, a resource essential to interstellar trade and political dominance. This conflict between imperial forces cocooned with a corporation and the Indigenous Fremen people, the last fighting to preserve their land and culture, mirrors modern debates on neo-extractivism.[iv] and the Indigenous Fremen people, who had previously fought to maintain their land and culture, which sets the scene for contemporary debates on neo-extractivism.[v]ation and the Indigenous Fremen people, the last fighting to preserve their land and culture, mirrors modern debates on neo-extractivism.[vi] and the Indigenous Fremen people, the last fighting to preserve their land and culture, mirrors modern debates on neo-extractivism.[vii]

This research uses Dune as a speculative mirror to examine the legal and political structures of resource extraction in space law under the TWAIL framework, aiming to explore how the novel's themes of imperialism, resistance, and environmental justice offer insights into modern discussions on space resource governance. Through this analysis, we unpack how Dune critiques neo-extractive [viiiix] linking the Fremen's struggle against imperial domination to contemporary resistance movements against resource exploitation on Earth and beyond. Therefore, the study follows a symptomatic reading of the novel, treating *Dune* not just as an illustration but as a site of legal and political contestation, thereby moving the text from a mere cultural artifact to a primary source of political and legal theory.

Meanwhile, TWAIL exposes how international space law privileges technologically advanced nations and corporate interests, sidelining developing countries and marginalized communities—the Fremen's struggle against imperial domination to contemporary resistance movements against resource exploitation on Earth and beyond. Meanwhile, TWAIL exposes how international space law privileges technologically advanced nations and corporate interests, sidelining developing countries and marginalized communities.Fremen's struggle against imperial domination to contemporary resistance movements against resource exploitation on Earth and beyond. Meanwhile, TWAIL exposes how international space law privileges technologically advanced nations and corporate interests, sidelining developing countries and marginalized communities.

By blending literary critique and legal theory, this study offers a deeper understanding of how Dune serves as both a cautionary tale and a framework for rethinking the international law of space and the national laws that regulate it. The paper highlights, through this interdisciplinary approach, the imperial legacies embedded in space exploration and its regulatory framework.

The paper is structured into three sections. First, we define the theoretical framework, incorporating postcolonial studies, TWAIL, Marxism, and SF analysis. Second, we evaluate the current state of international space law and identify its structure. Third, we apply Dune's narrative through the lens of space neo-extractivism.

II. THEORETICAL FRAMEWORK

Postcolonial science fiction examines the long-lasting effects of cultural imperialism on science fiction, emphasizing the ongoing contacts and exchanges between different cultures worldwide (aliens) and direct colonial history (Harding, 2004). Its roots can be traced to Edward Said, who emphasized the need to understand the historical background of imperialism and its influence on the relationships between Western countries and other parts of the world, not only the political and economic dynamics but also the cultural and intellectual dimensions. As such, the role of culture in the empire is to legitimize and facilitate the dominion over foreign territories and peoples, in which literary and artistic forms express and promote imperial endeavors, shaping how other cultures are perceived and misrepresented (Said, 1994).ng how other cultures are perceived and misrepresented (Said, 1994).

The point of contact between postcolonial studies and SF is usually the colonial encounter between the superior moral civilization and the aliens, in which the SF literature is "[…] a work written by and for Western civilization could not properly understand the suffering of the minority" (Yacine and Majdoubeh, 2023, p. 501). These topics, such as race and resistance to domination, focus most analyses on the intersection between postcolonial studies and SF. analyses on the intersection between postcolonial studies and SF.

Langer (2011) introduces the concept of SF as a narrative framework for exploring and critiquing the effects of colonialism, proposing that science fiction uniquely enables a reimagining of past colonial impacts and future possibilities. By drawing on the works of Edward Said, Homi Bhabha, and Gayatri Spivak, the author argues in favor of SF as a genre that can express and convey complex ideas about identity, culture, and power dynamics, exposing the neocolonial structures that emerged after the resistance movements in the Third World (Young, 2003).

Within this framework, our contribution in this paper is to connect international law to colonial power dynamics observable in science fiction. For that reason, we mobilize TWAIL to deal with the imperial origins of international law and its perpetuating exclusionary features (Anghie, 2024).

At the international system level, the rhetoric of States is born, constituting an ideological struggle to justify European expansion during the period of the great navigations under the argument of the mission civilizatrice, which is still used today by the Western powers to impose a model of development that is not working. The rationale for this expansion's continuity is the idea of universal values and truths imposed by natural law on everyone. The appeal to universalism takes four primary forms today: 1) the policy followed by Western leaders defends human rights and democracy; 2) there is a civilization clash; 3) the market economy is the only alternative system for development, leaving only governments to accept, and 4) the necessary technology to deal with the problems caused by capitalism will save us.

The imposition of the universal ideology or metanarratives becomes fundamental to guarantee the expansion of the state's national interests. At the same time, it consolidates ideology within international institutions to ensure its legitimacy has a scientific and rational basis (Lyotard & Jameson, 1984). Therefore, it is a historical and intentional political process to overcome the resistance outside pan-European circles that persists in the twenty-first century. Hence, international law or ius publicum Europaeum assumes an instrumental role in Western powers pushing their agendas in international institutions, which, for Mattei (2013, p. 268):

The rhetorical artifice used in the process of curbing deviant behavior and claiming, as universal and inevitable, the Western modalities of social organization and economic development centered on individualism and social fragmentation is usually an explicitly juridical concept: "international human rights." In the interests of these rights, a doctrine of "limited sovereignty" has threatened the traditional nature of international law as a decentralized system based on territoriality and has advocated the need for decentralization to make it more like any other West national legal system.

TWAIL and postcolonial SF provide the theoretical framework for examining the tendency of neo-extractive activities in space to search for new sources of mineral commodities to sustain business-as-usual consumerism and capital accumulation. These approaches applied to space exploration will help address the question posed by Deudney (2020, p. xxxviii): "[…] can humanity develop the foresight capacities to accurately anticipate which novel technological capabilities open paths to actual progress and which lead to the slippery slopes of a civilizational and species abyss?"

Now, let us map the current international space law before tracing the empirical indicators in Dune.

III. SETTING THE STAGE: SPACE IMPERIALISM

International space law instruments were developed during the Cold War era in response to rapid advances in space technology and the competition between the United States and the Soviet Union in the space race. The 1957 launch of Sputnik, the Soviet Union's inaugural artificial satellite, was a crucial landmark that underscored the pressing need for a legal framework governing nations' activities in outer space (Pankova, 2021).

Some dynamics were crucial for the formation of international space law. First, the space race was a significant element of the Cold War, showcasing the technological and ideological dominance competition between the USSR and the USA, accelerating the advancement of space technology, and prompting the need for rules to ensure the peaceful use of outer spacexxi Second, the possibility of outer space becoming a new battleground for Cold War tensions, there were initiatives to establish legal principles that would guarantee space as a demilitarized zone. Third, the scientific advantages of space were regarded as a shared resource accessible to everybody, and there was a universal acknowledgment that cooperation may result in increased advantages for the entire human race. Finally, significant advancements in technology and exploration, such as manned spaceflights and missions to the moon during the 1960s, emphasized the necessity for regulations of the safety and rescue of astronauts, liability for damages caused by space objects, and the registration of objects launched into outer space (Muszyński-Sulima, 2023).ignificant advancements in technology and exploration, such as manned spaceflights and missions to the moon during the 1960s, emphasized the necessity for regulations of the safety and rescue of astronauts, liability for damages caused by space objects, and the registration of objects launched into outer space (Muszyński-Sulima, 2023).

In response to these dynamics, several key treaties were formulated under the auspices of the United Nations General Assembly, specifically through its Committee on the Peaceful Uses of Outer Space (COPUOS).xii It has helped to form an international regime for space initially focused on security and cooperation, which has been challenged by the acceleration of new technologies and actors (Adar, 2022). The existing legal instruments for regulating space activities are:

Table 1. Legal Instruments Related to Space Exploration (made by the author).

Treaty Name	Description
Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967)	The backbone of space law, this treaty establishes principles governing the exploration and use of outer space, including the prohibition of nuclear weapons in space, the freedom of exploration, and the right of all countries to explore and use space.
Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (1968)	It focuses on rescuing astronauts and returning objects launched into space.
Convention on International Liability for Damage Caused by Space Objects (1972) and the Convention on Registration of Objects Launched into Outer Space (1975)	These treaties are guidelines for liability for damage caused by space objects and the registration of space objects, enhancing safety and accountability in space activities.
Agreement Governing the Activities of States in the Moon and Other Celestial Bodies (1979)	Though less widely ratified, this treaty attempted to extend the principles of the Outer Space Treaty to the moon and other celestial bodies, particularly in regulating the exploitation of their resources.

A typical thread that binds these legal pieces together is the normative development imperative. The language exerted in article 11 (7) (a, b, and c) of the Agreement Governing the Activities of States in the Moon and Other Celestial Bodies (1979) makes it clear: "7. The main purposes of the international regime to be

established shall include (a) the orderly and safe development of the natural resources of the moon; (b) the rational management of those resources; (c) the expansion of opportunities in the use of those resources […]."the orderly and safe development of the natural resources of the moon; (b) the rational management of those resources; (c) the expansion of opportunities in the use of those resources […]."

The rush for space domination expanded exponentially during the Cold War, pushing Third World countries to respond to technological exclusion. The Bogota Declaration of 1976 was issued by eight equatorial countries (Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda, and Zaire—now the Democratic Republic of the Congo)xiii in an attempt by these nations to assert sovereignty over the segments of the geostationary orbit that are directly above their territories.xiv in an attempt by these nations to assert sovereignty over the segments of the geostationary orbit that are directly above their territories.

The Bogota Declaration raised four points based on the geostationary orbit directly above the equator. First, the geostationary orbit should be considered a natural resource over which the equatorial states exercise sovereignty. Second, the challenge posed by the principles of outer space law, particularly those laid out in the Outer Space Treaty of 1967, which could lead to claims of special rights over the geostationary orbit directly above them. Third, comparing the geostationary orbit to the continental shelf, countries argue that these slots are part of their territory and thus under their jurisdiction and control. Fourth, countries foresaw the potential economic and communication advantages that could be derived from controlling access to these orbital positions, fearing that great powers would monopolize these valuable orbital slots without regard for the interests of equatorial states (Klein 2020). (Klein 2020).

Although the Declaration did not change international law regarding space, it remains a critical reference point in discussions of space sovereignty, the equitable distribution of orbital slots, and the regulation of satellite placement in geostationary orbit. The Declaration can be seen as a corollary of the Bandung Conference (1955) in its resistance to imperialism, as it debated the role of the Third World in economic development and decolonization. The Declaration highlights the ongoing tensions between developing and developed nations over the benefits derived from space resources and the governance of outer space.

A closer look at the existing legal framework for space exploration shows that, with the end of the Cold War, the agenda-setting states in this area turned inward to build their national legal frameworks for space exploration. This can be empirically verified by the fact that international legal instruments regarding space exploration have not been revised or updated to account for the introduction of new technologies and non-state actors.

Today, we see a new kind of space colonialism that does not involve flags and conquests but operates through legal frameworks, economic monopolies, and technological gatekeeping. Western powers created these institutions to reflect their values and interests,xv which are exclusionary, lacking representation and participation of non-Western countries and marginalized groups in these institutions, leading to decisions and policies based on Western perspectives and priorities that do not consider the diverse needs and experiences of different regions and communities, thus, perpetuating power imbalances and exacerbating existing inequalities (Muszyński-Sulima, 2023; Escobar, 2011).xvi

Transnational corporations such as SpaceX drive the modern space economy, and state-led initiatives like the Artemis Accords (spearheaded by NASA, the United States's space agency) are empirical stances of xvii While international space treaties still refer"""""""peaceful """"""""" """"the benefit of all ma" """""""" space remains a domain of exclusion, competition, and economic extraction, much like the past colonies. For instance, related to the object of this study, the Artemis Accords state that the extraction of natural resources in outer space is bound to the principle: is bound to the principle:s in outer space is bound to the principle: is bound to the principle:

The ability to extract and utilize resources on the Moon, Mars, comets, and asteroids will be critical to support safe and sustainable space exploration and development. Space resource extraction and utilization under the Artemis Program will be conducted in compliance with the Outer Space Treaty.xviii

It is problematic to observe that the narratives of space exploration nowadays are based on a colonial legal framework (Table 2), led by developed countries that transfer the most considerable portion of space exploration to capitalist ventures that are primarily bound to fiduciary duties to shareholders (see the relationship between SpaceX and the United States government, specifically with NASA and the Department of Defense).xixxx

The imposition of the metanarrative of this development model, embedded in the normative international liberal order, becomes the standard of civilization that enables them to assess the international community (Anghie, 2007). This imperial device is confirmed by Donald Trump's utterances when launching America's first National Space Strategy in 2020: "We are a nation of pioneers. We are the people who crossed the ocean, carved out a foothold on a vast continent, settled a great wilderness, and then set our eyes upon the stars. This is our history, and this is our destiny."xxi This is what Frederick Jackson Turner, cited by Marshall (1995), calls "fronteirism," a normative discourse that invokes a romanticized and heroic venture in favor of humankind. As such, the communicative stance by the United States and international institutions is "[…] one which continues to reaffirm assumptions which are 'rooted in coloniality, specifically the conceptions of humankind, peace, nature and economic relations." (Adar, 2022, p.98) (See Table 2). (See Table 2). . (See Table 2).

Table 2. Principles in International Space Law vis-à-vis Postcolonial Critique (made by the author).

Colonialist Principle in Space Law	Legal Basis	Postcolonial Critique (Bandung/Bogotá)
Common Heritage of Mankind (CHM)	Moon Agreement (1979), OST (1967)	CHM benefits spacefaring nations, while non-spacefaring nations remain dependent.
No Sovereignty in Space (Res Nullius)	OST (1967), Article II	Prevents developing nations from asserting resource rights, while allowing de facto control by powerful states.
"Peaceful Use" Narrative	OST (1967), Article III	Western nations dictate interpretations of "peaceful" use, excluding Global South perspectives.
Legalization of Technological Exclusion	OST (1967), Article I	"Equal access" exists only in principle; technological and financial barriers reinforce dependency.
Control over Geostationary Orbit (GSO)	ITU Regulations (1963), OST (1967)	The Bogotá Declaration (1976) rejected this but was ignored by spacefaring powers.

In this sense, Marshall (1995, p.49) is unequivocal in framing the imperialistic nature of space exploration:

It will be undertaken by a few technologically elite space-capable nations who will appropriate the commonly-owned resources of the Solar System for themselves, without any committed provision for the sharing of the benefits to other, non-space capable, nations. Unfortunately such imperialistic tendencies are not just a prospect for the future, they are evident in current space activities…For instance, with the continued development of the geostationary orbit, concern is being expressed that the space a satellite occupies in this type of orbit is becoming a scarce resource, and one which is becoming increasingly unavailable to non-space nations.

Upon these arguments, the study finds that Global South countries face three hurdles in terms of space exploration in general, and mining specifically. First, there are scientific and financial barriers to the entrance for space mining. Second, there are gaps in governance related to the lack of a clear, universally accepted international system regulating space resource extraction, ownership, and benefit-sharing, which raises questions about possible conflict or exploitation. Third, space mining could aggravate global economic imbalances without robust, fair government systems and real technology transfer (Adar 2022).

These findings are not incompatible with the arguments favoring space exploration and mining. For instance, Fleming et al. (2023) argue that space mining causes sustainable development as energy transition demands minerals that outer space can furnish, thus decreasing the pressure on their extraction in developing countries. Also, Hornsey et al. (2022) point out that perceptions of space mining are more favorable than those of mining in deep-sea or Antarctic environments, due to the protection of these delicate environments against mining, which also contributes xxiidecrease in the ideological divide and pressures in civil society.xxiii The Secure World Foundation is increasingly positive in making the case for space mining, arguing that it contributes directly to several of the United Nations Sustainable xxivGoals.[OBJ] Although space is already being explored, producing the knowledge related to the exploitation of celestial bodies to grab

minerals, many legal, policy, and technical uncertainties remain to be clarified to make space exploration beneficial to developing countries.[OBJ] xxv

As such, before proceeding to the next section, it is worth noting that, when it comes to neo-extractivism in space, international institutions' concealment of such activities and their detrimental consequences for the environment and developing countries is "stellar." Despite the growing tendency of neo-extractivism in space and the attention given by the media, the 2023 Report of the Committee on the Peaceful Uses of Outer Space, approved by the General Assembly of the United Nations (36th session), lacks any mention of related terms such as "mining" or "extractivism" (Figure 1). session) lacks any mention of related terms such as "mining" or "extractivism" (Figure 1). " (Figure 1). session) lacks any mention of related terms such as “mining” or “extractivism” (Figure 1).

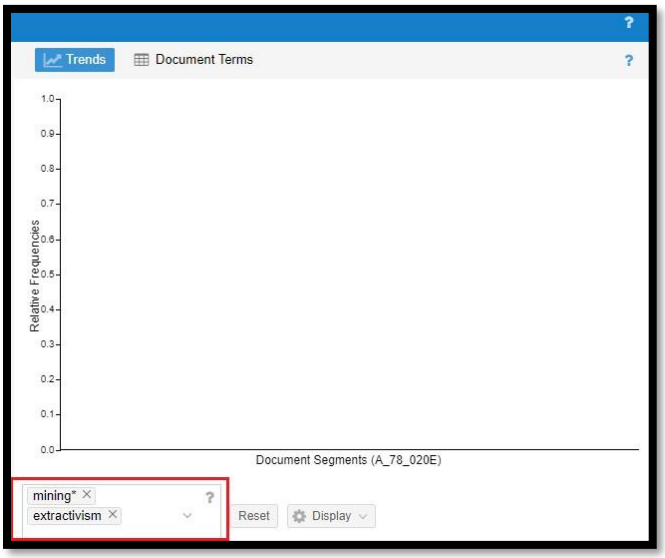

FIGURE 1. Content Analysis of the Report of the Committee on the Peaceful Uses of Outer Space, Sixty-sixth session (31 May–9 June 2023) (made by the author using Voyant Tools – the data can be retrieved from https://voyant-tools.org/?corpus=cc74129ae006861b0bb4e4ec40e1791c&lang=en).

Therefore, after presenting the legal and political backgrounds to space exploration vis-à-vis the proposed theoretical framework for this study, we turn to neo-extractivist activities in outer space. In this regard, our analysis is guided by the plot staged in Dune.

IV. DUNE: "HE WHO CONTROLS THE SPICE CONTROLS THE UNIVERSE."

As the theoretical framework poses, the concealed message in SF under the postcolonial literature traces a parallel of space exploration with the European navigation period in terms of the encounter with the "other" or the alien that needs to adapt to the space explorer (see, for instance, Dr. Spock from the planet Vulcan, that to be integrated as a crew member of the USS Enterprise, needs to learn how to be "more human" emotions to navigate the complexities in the spaceship), the plundering of natural resources, and the existence of anti-colonial movements against imperial domination (Seed, 2010; Decker & Eberl, 2008). anti-colonial movements against imperial domination (Seed, 2010; Decker & Eberl, 2008). 8). anti-colonial movements against imperial domination (Seed, 2010; Decker & Eberl, 2008).

The normative language of colonization of space in science fiction pieces reflects the existing structures of domination. First, it reflects a heroic image of a class of people engaging in space exploration for the benefit of humankind, the "space barons" as referred to by Gunderson, Stuart, and Petersen (2021, p. 2), or in other words, the construction of a cultural narrative that includes elements of refinement and elevation (Said,

1994). Second, it generates a robust ideological framework for space exploration that hinders the actual beneficiaries of this entrepreneurship: the transnational companies backed up by far-right, pro-business, anti-regulation politicians (Adar, 2022). Third, the propagation of narratives in such pieces generates cultural uniformity (or conformity), consistent with the principle of universalization in international law that excludes non-Western cultures and traditions as "exquisite" or "weird."xxvi Space exploration analyzed from a historical perspective points out the Ibero missions to America, which, by "[…] stealing the land that made this resource extraction possible, colonizers used genocide, enslavement, biological weaponry, and warfare and that resulted in the deaths of tens of millions of indigenous people living in the "New World."xxviixxviii Space exploration analyzed from a historical perspective points out the Ibero missions to America, which by "[…] stealing the land that made this resource extraction possible, colonizers used genocide, enslavement, biological weaponry, and warfare and that resulted in the deaths of tens of millions of indigenous people living in the New World.xxixstealing the land that made this resource extraction possible, colonizers used genocide, enslavement, biological weaponry, and warfare and that resulted in the deaths of tens of millions of indigenous people living in the "New World."xxxxxxi Space exploration analyzed from a historical perspective points out the Ibero missions to America, which by "[…] stealing the land that made this resource extraction possible, colonizers used genocide, enslavement, biological weaponry, and warfare and that resulted in the deaths of tens of millions of indigenous people living in the "New World."xxxii

As such, Dune is an SF novel that relates directly to the neo-extractivist practices the world experiences nowadays to sustain what Brand & Wissen (2021) call the "imperial mode of living." The lens of postcolonial studies applied to Dune challenges modernity for its imperialist incursions, reductionism, rationality, racism, and limitless will to power, which makes it a powerful counter-hegemonic tool to the mainstream SF that sees space exploration as part of the human endeavor to dominate and explore nature. Dune demonstrates through SF narrative that imperialism is universal and perennial in the aspects of greed for resources and ruthless self-interest, or in other words, the novel is "[…] "not merely critiquing an abstract, mythological imperialism, but wanted to show via the allegory with contemporary American imperialism in the Middle East that imperialism is alive and well [...]" (Hoagland & Sarwal, 2010, p.15-6). To that end, in this part of the study, we will intercalate the exposure of fiction and reality using Dune and the space exploration regime." (Hoagland & Sarwal, 2010, p. 15-6). To that end, in this part of the study, we will intercalate the exposure of fiction and reality using Dune and the space exploration regime. e and well [...]" (Hoagland & Sarwal, 2010, p.15-6). To that end, in this part of the study, we will intercalate the exposure of fiction and reality using Dune and the space exploration regime. " (Hoagland & Sarwal, 2010, p.15-6). To that end, in this part of the study, we will intercalate the exposure of fiction and reality using Dune and the space exploration regime.

The narrative centers around the youthful protagonist, Paul Atreides, and his family, the House Atreides, who oversee the arid planet Arrakis or Dune, the sole origin of 'spice,' a precious substance that prolongs life, augments cognitive capabilities, and makes it possible to travel in space "without moving" by folding the universe, thus, making Arrakis the pivotal source of power in the entire universe (Herbert, 1990)..(Herbert, 1990).

The Known Universe is composed of four planets and ruling houses that emerged from the Great Revolution, which some of them profited from it, as "[..] many saw the thousands of divided planets as ripe fruit for plucking" (McNelly 1984, p. 202). The planets are:

- Planet Arrakis, the source of spice and the home of the desert people known as Fremen.
- Planet Caladan, the home of the House Atreides.
- Planet Giedi Prime, the home of the House Harkonnen.
- Planet Kaitain, the home of Emperor Padishah Shaddam, the Fourth.

As we can observe from this structure, Dune is binary in the sense that one planet is the source of conflict due to the extraction of the "spice" (Arrakis), and two houses compete for access to and control of the "spice" (Atraides and Harkonnen) under the auspices of the supreme imperial power sitting in Kaitain. This encounter parallels in the 17th century, when European monarchs tightly controlled trade, believing that national wealth and power depended on accumulating gold and silver. This similarity led to the rise of monopolistic trading companies, such as the British East India Company and the Dutch East India Company, which were granted exclusive rights to conduct business in foreign lands. These companies didn't just trade - they acted as arms of the state, using military force to secure resources and eliminate competition. Spices,

textiles, and precious metals became the prizes of a global economic race, fueling colonial expansion and conflicts. While these monopolies made European nations incredibly wealthy, they also created deep economic dependencies in their exploited regions (Ekelund, 1982). This system shaped the modern world, laying the foundation for global trade as we know it today, and mirrors space exploration (see the relationship between NASA and SpaceX we discussed in the last part).[xxxii] This system shaped the modern world, laying the foundation for global trade as we know it today, and mirrors space exploration (see the relationship between NASA and SpaceX we discussed in the last part).xxxiii British East India Company and the Dutch East India Company, which were granted exclusive rights to conduct business in foreign lands. These companies didn't just trade - they acted as arms of the state, using military force to secure resources and eliminate competition. Spices, textiles, and precious metals became the prizes of a global economic race, fueling colonial expansion and conflicts. While these monopolies made European nations incredibly wealthy, they also created deep economic dependencies in their exploited regions (Ekelund, 1982). This system shaped the modern world, laying the foundation for global trade as we know it today, and mirrors space exploration (see the relationship between NASA and SpaceX we discussed in the last part).xxxiv , 1982). This system shaped the modern world, laying the foundation for global trade as we know it today, and mirrors space exploration (see the relationship between NASA and SpaceX we discussed in the last part).xxxv

Upon relocating to Arrakis, the Atreides family becomes enmeshed in a complex network of political machinations and treachery orchestrated by their adversary, the House Harkonnen. Paul and his mother, Lady Jessica, flee to the desert, where they come into the Fremen, the indigenous inhabitants of Arrakis. Paul fully accepts his predetermined role as a predicted leader. He effectively utilizes Fremen's unconventional warfare strategies to confront and oppose the harsh governance of the Emperor and Harkonnens (Herbert, 1990).

In the work, Herbert explores issues such as survival, the management of natural resources, and the messianic trip undertaken by the main character. The fundamental theme of the plot revolves around Paul's metamorphosis into the messianic character known as Muad'Dib, a symbol of his development into a leader who skillfully manipulates ecology, politics, and religion to improve his planet. This transformation is a crucial aspect of the novel, celebrated for its profound philosophical observations, intricate character development, and meticulous construction of a fictional universe, establishing it as a fundamental work in the genre of science fiction literature. aspect of the novel, celebrated for its profound philosophical observations, intricate character development, and meticulous construction of a fictional universe, establishing it as a fundamental work in the genre of science fiction literature.t, and meticulous construction of a fictional universe, establishing it as a fundamental work in the genre of science fiction literature. aspect of the novel, celebrated for its profound philosophical observations, intricate character development, and meticulous construction of a fictional universe, establishing it as a fundamental work in the genre of science fiction literature.

Dune came out in the middle of the 1960s, a decade considered the historical marker for the environmentalist movements due to the deterioration of the environment, followed by the unprecedented industrialization and urbanization in Europe and the United States after World War II. The release of Rachel Carson's book Silent Spring in 1962 stimulated public apprehension regarding the use of pesticides and their ecological consequences, signifying a crucial turning point in the development of the movement (Montague & Pellerano, 2024). Also, when Dune was written and published, the world observed waves of decolonization and disenchantment of the status quo of hegemonic domination of the international economic order (Jansen and Osterhammel, 2019). uo of hegemonic domination of the international economic order (Jansen and Osterhammel, 2019). .

Directly related to the nonrenewable characteristic of the spice, the object of desire in Dune, the increasing degree of industrialization and urbanization worldwide puts heavy pressure on oil production and transportation. The 1967 War was a significant turning point in Middle Eastern history and the formation of the worldwide oil market. The conflict resulted in substantial geopolitical changes that profoundly influenced global oil production, pricing, and delivery networks. After the war, several significant occurrences transpired that further delineated the contemporary framework of the worldwide oil industry. Over the next ten years, OPEC emerged as a prominent force in the global oil industry, exerting substantial control over oil prices in the early 1970s, reaching its peak with the 1973 oil embargo. The imposition of this

embargo was a direct response to the Western assistance provided to Israel during the 1973 Yom Kippur War, which further solidified the interconnection between global oil markets and Middle Eastern geopolitics. The embargo resulted in significant oil shortages and exorbitant prices throughout the Western region, causing a fundamental shift in consumer behavior and energy-related government policies (Goldstein, 2018). These events triggered a sequence of modifications in the trading, pricing, and perception of oil from the national security perspective (Drezner, 2024). The spice plays on the same fear, which acts as a catalyst in the minds of the nobles and merchants in Dune.

The extraction of spice from Arrakis is the most critical activity, as it is "[…] the most precious thing in the universe," (Herbert, 1990, p. 829) even more crucial for the Emperor and Harkonnens than water, as technology has made it possible to extract it from urine and feces using the stillsuit. Only Fremen, the original people who live in Arrakis, understand the importance of water, making efforts to store water in subterranean reservoirs (Herbert, 1990, p. 973).[xxxv] This reflects the disregard for traditional knowledge in favor of the capitalist approach in which technology is the tabula rasa that will provide an exit or solution, as reflected in many devices generated by capitalism to deal with its internal contradictions to keep the accumulation process (Huesemann & Huesemann, 2011). [xxxv] reflects the disregard for traditional knowledge in favor of the capitalist approach, "technology will save us," as reflected in many devices generated by capitalism to deal with its internal contradictions to keep the accumulation process (Huesemann & Huesemann, 2011). xxxvi . This reflects the disregard for traditional knowledge in favor of the capitalist approach, “technology will save us,” as reflected in many devices generated by capitalism to deal with its internal contradictions to keep the accumulation process (Huesemann & Huesemann, 2011). xxxvii

The planet Arrakis is the only source of spice in the known universe that is subject to the greed of the Emperor, who uses the House of Harkonnen to deter the emergence of the Kwisatz Haderach, the savior as prophesized in the traditions of the uncivilized Fremens, thus, making sure that the flow of spice is not interrupted, or otherwise the CHOAM would lose money and therefore would not be able to distribute the profits among the Emperor, Harknonnen, and its shareholders. It is possible to trace the imaginary in Dune with the imperial powers in the world, as posed by Chanda (2007, p.186) that "[…] religious fervor often combined with greed to drive imperial ambition," which in Dune beyond the religious dimension, the CHOAM (what we could call nowadays transnational companies, the old multinationals) (McnNelly, 1984, p.227).

The mercantile impulse that led European countries to initiate colonial ventures shows that the response to capital disaccumulation pushed elites to begin the plundering process elsewhere.xxxviii The same impulse is observed in neo-extractivist activities in space, which, to Hickel (2021, p.1), "[...] economic growth in the North relies on colonization patterns: the appropriation of atmospheric commons, and the appropriation of Southern resources and labor."

Arrakis suffers from the so-called curse of natural resources, a phenomenon in which countries abundant in natural resources tend to have a lower economic growth rate than nations with fewer resources. Prior research predominantly affirmed that natural resources could harm economic growth due to difficulty achieving economic diversification and political instability (Gómez-Barris, 2017). Recent research employing advanced econometric models indicates that natural resources may bolster economic performance in specific circumstances, such as enhanced governance and investment in human capital (Kinnaman, 2023). Despite the debates, it is empirically verifiable that the legacies of colonization based on extractive industries led the Global South to unequal power dynamics and environmental degradation, which continues to shape the neoliberal development model today (Rodney & Davis, 2018). One of the empirical stances is the plundering of gold, which involved the conquest and colonization of territories rich in gold and the forced labor of enslaved peoples, laying the foundation for capital accumulation through various means that continue to have an impact today. Gold was a valuable resource used to finance the growth of capitalist economies. The gold sold in Europe was instrumental in funding the Industrial Revolution, consolidating the European banking system, and accelerating international trade, remaining a valuable commodity still actively extracted from the Earth and traded on global markets, contributing to what Marx referred to as primitive accumulation (Galeano & Allende, 1997).xxxix achieving economic diversification and political instability (Gómez-Barris, 2017). Recent research employing advanced econometric models indicates that natural resources may bolster economic performance in specific circumstances, such as enhanced governance and

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Therefore, it doesn't matter what natural resource is needed or where it is located; adventurers or explorers will overcome the technological, legal, and political limitations to access it and make it available in the market. Resource extraction and exploitation patterns follow the capitalist demand for continuous expansion (Svampa, 2022).

As for the recent trend to surpass earthly natural limitations to access minerals, the same logic is applicable. Under a Marxist approach, Fisher (2009) indicates how capitalism has infused itself into every aspect of modern life, shaping economic systems and cultural and psychological norms in which Dune. He argues that capitalist realism is the widespread sense that not only is capitalism the only viable political and economic system, but also that it is now impossible even to imagine a coherent alternative to it.xlii To that end, Fisher's (2009) analysis can trace the existing parallels between Dune and space neo-extractivism:

	Dune	**Reality**
Normalization of Exploitation	Mining of Arrakis for spice in Dune normalizes the exploitation of planetary resources	Mining in space normalizes inherent exploitation in capitalism
Impossibility of Alternatives	Arrakis is the only source of spice	The natural limitation of Earth impedes development – disaccumulation is an existential threat to capitalism
Perpetuation of Imperial and Colonial Dynamics	Monopolistic control over spice by the Empire - colonial dynamics	Technofeudalism in space mining is in the hands of Global North transnational companies

Table 3: Dune X Reality (made by the author)

As such, we can observe the broader implications of space neo-extractivist and interstellar exploitation narratives. These narratives show how deep-seated economic ideologies shape not just terrestrial but also potential extraterrestrial futures in an imperialistic and colonialist continuum in search of energy sources. There are some CHOAMs nowadays in charge of sustaining the flow of the spice. Contrary to earthly neo-extractivism in which there are no direct international norms to regulate it (there are rules about biodiversity, climate change, and transboundary pollution related to mineral extractivism), space neo-extractivism is regulated by international law as we mapped out before, thus, the CHOAMs are operating under the auspices of the governments that built the international spaxliiixliv xlv

In Table 4 below, we list the ten most prominent space-mining companies. Seven of them are based in the United States, which is understandable given the US$73.2 billion investment in 2023. The others are in Europe (2) and Japan (the latter with the third-most significant investment in space programs).xlvi

Table 4. Space Mining Transnational Companies in the World (made by the author).

Company Name	Space Neo-extractivist Activity	Country of Origin
Moon Express	Focuses on exploring the lunar surface for resources	United States
Trans Astronautic Corporation	Involved in developing technology for asteroid mining	United States
Off-World, Inc.	Specializes in robotic mining technology for extraterrestrial applications	United States
Asteroid Mining Corporation	Works on projects to harness resources from asteroids	United Kingdom
iSpace, Inc.	Engages in lunar exploration and mining	Japan
Karman+	Develops technology for mining water from near-Earth asteroids	United States
Astrobotic Technology, Inc.	Provides robotic spacecraft for lunar and planetary missions	United States
Momentus Space	Offers infrastructure services for the space economy, including for mining missions	United States
RHEA Group	Involved in engineering and system solutions, including those applicable to space resources	Belgium
AstroForge	Aims to mine asteroids for valuable minerals to be used on Earth	United States

Astroforge, the real version of the CHOAM company in Dune, represents a compelling example of the new generation of space mining companies operating within an industry increasingly dominated by US-based entities. Founded in the early 2020s and headquartered in California, Astroforge has attracted significant investment, totaling over $55 million, to pursue the ambitious goal of mining asteroids.xlvii

The space mining sector exhibits a notable concentration of activity within the United States. As indicated in the user's initial premise, seven of the ten most prominent companies in this field are US-based, a direct reflection of the substantial national investment in space activities, which reached $73.2 billion in 2023. The preponderance of American firms suggests a supportive ecosystem extending beyond mere financial capital. Factors such as access to a skilled labor pool, particularly aerospace engineers with relevant experience (as evidenced by the Astroforge founders' backgrounds at companies like SpaceX and Virgin Orbit), are crucial.xlviii Furthermore, the presence of establixlix including commercial launch providers like SpaceX, which Astroforge utilizes through rideshare agreements with partners like Intuitive Machines, significantly

lowers entry barriers. While the regulatory landscape for commercial deep-space activities is still evolving, the granting of the FCC license to Astroforge for deep-space communications indicates a pathway, albeit nascent, for US regulatory engagement with these new commercial frontiers.l This confluence of capital, talent, infrastructure, and a developing regulatory framework contributes to an environment conducive to US-based space mining ventures. founders' backgrounds at companies like SpaceX and Virgin Orbit), are crucial. Furthermore, the presence of established supply chains, including commercial launch providers like SpaceX, which Astroforge utilizes through rideshare agreements with partners like Intuitive Machines, significantly lowers entry barriers. While the regulatory landscape for commercial deep-space activities is still evolving, the granting of the FCC license to Astroforge for deep-space communications indicates a pathway, albeit nascent, for US regulatory engagement with these new commercial frontiers. This confluence of capital, talent, infrastructure, and a developing regulatory framework contributes to an environment conducive to US-based space mining ventures.agreements with partners like Intuitive Machines, significantly lowers entry barriers. While the regulatory landscape for commercial deep-space activities is still evolving, the granting of the FCC license to Astroforge for deep-space communications indicates a pathway, albeit nascent, for US regulatory engagement with these new commercial frontiers.li This confluence of capital, talent, infrastructure, and a developing regulatory framework contributes to an environment conducive to US-based space mining ventures. founders' backgrounds at companies like SpaceX and Virgin Orbit), are crucial.lii Furthermore, the presence of established supply chains, including commercial launch providers like SpaceX, which Astroforge utilizes through rideshare agreements with partners like Intuitive Machines, significantly lowers entry barriers. While the regulatory landscape for commercial deep-space activities is still evolving, the granting of the FCC license to Astroforge for deep-space communications indicates a pathway, albeit nascent, for US regulatory engagement with these new commercial frontiers.liii This confluence of capital, talent, infrastructure, and a developing regulatory framework contributes to an environment conducive to US-based space mining ventures.

As such, Astroforge reflects the current dynamics of the US space mining sector, which is characterized by high investment, ambitious technological goals, and the influence of a maturing commercial space ecosystem. These findings reinforce the exclusion of developing countries from space exploration ventures, thus, confirming the coloniality of the principles and rules related to space in Table 2 and their parallel with Dune in Table 3.liv

The language used in space discourse often reflects colonial ideologies and techniques, which can obscure the historical realities and experiences of colonization and exploitation acquired by the Global South. The common usage of terms associated with conquest and colonization as the teleological mission for humankind is prevalent, suggesting a continuation of colonial attitudes in modern space activities and reflected in sci-fi literature (Adar, 2022). This language is applied from a utilitarian perspective that disregards the impacts (social, economic, and environmental) on the Global South countries but exalts the social and economic benefits brought by the activities of transnational companies with headquarters in the Global North (do not forget that as much as these companies are doing a good deed to humankind if the shareholders are not making money…). As pointed out earlier, the privileged lv should lvias part of the sovereignty of the Global South countries; therefore, a seat at the table in terms of sustaining a sense of concrete global solidarity.lvii

The neo-extractivist rush in outer space is instrumental to primitive accumulation as the natural limitations of Earth's reserves are fixed. The necessity of accumulation relies on using nature and a growth model that relies on the excessive exploitation of natural resources, primarily non-renewable, known for its extensive scope and focus on exports as one of the global market demands (Svampa, 2022). It generated important implications for the global economy and regulation as a component of a complex system of practices, and power imbalances that support and justify social and environmental damage and conflicts (Veltmeyer, 2022; Scott, 2021).Veltmeyer, 2022; Scott, 2021).Svampa, 2022). It generated important implications for the global economy and regulation as a component of a complex system of practices, and power imbalances that support and justify social and environmental damage and conflicts (Veltmeyer, 2022; Scott, 2021).

The boom of commodities in the early 21st century has generated an exponential over-exploitation of land and natural resources in developing countries, and expanding into new territories, thus, exacerbating the social and environmental problems, reflecting a contemporary development model with denunciatory

and mobilizing aspects (Langlois & Canul, 2023).lviii As such, the emergence of neo-extractivism refers to conflicts arising from the expansion of extractive industries, which possess specific characteristics that differentiate it from the extractivism, such as state involvement and redistribution, economic diversification attempts, continued dependency on global markets, response to global demands, sustainable development claims, and social and environmental conflicts (Transnational Institute, 2024; Chagnon et al., 2022).

The story of Dune reflects a pattern we have seen throughout history—when a resource is valuable, those in power will do whatever it takes to control it, no matter the cost. Whether oil, gold, or spice, this endless pursuit of wealth has fueled wars, deepened economic inequalities, and devastated local communities. Arrakis, like many parts of our world, is trapped in a cycle of exploitation, where short-term profits take priority over long-term sustainability. The Fremen understand the value of water, just as many indigenous groups today fight to protect their lands and resources. Nevertheless, to the Empire and CHOAM, spice is the only thing that matters:

Few products escape the CHOAM touch," the Duke said. "Logs, donkeys, horses, cows, lumber, dung, sharks, whale fur—the most prosaic and the most exotic … even our poor pundi rice from Caladan. Anything the Guild will transport, the art forms of Ecaz, the machines of Richesse and Ix. But all fades before mélange (Herbert 1990, 24). rice from Caladan. Anything the Guild will transport, the art forms of Ecaz, the machines of Richesse and Ix. But all fades before mélange (Herbert 1990, 24).tic … even our poor pundi rice from Caladan. Anything the Guild will transport, the art forms of Ecaz, the machines of Richesse and Ix. But all fades before mélange (Herbert 1990, 24). rice from Caladan. Anything the Guild will transport, the art forms of Ecaz, the machines of Richesse and Ix. But all fades before mélange (Herbert 1990, 24).

The sandworms, essential for spice production, are under constant threat as much as real-world industries pushing countless species to the brink of biodiversity impacts and potential extinction. This greed-driven destruction of ecosystems forces us to ask: How far will we go before we realize that some things cannot be replaced? In the next section of the paper, we explore the ecological consequences of unchecked resource extraction embedded in extractivist cultures.

In Dune, the desert planet Arrakis is a fragile ecosystem where the exploitation of the spice has profound consequences for its environment and inhabitants. Similarly, space mining poses risks to extraterrestrial ecosystems and Earth's biodiversity, as we will point out later. Spice extraction threatens the delicate balance of Arrakis' ecosystem. Similarly, space mining could disrupt extraterrestrial environments, such as the Moon, asteroids, or Mars, which may harbor microbial life or unique geological formations:could disrupt extraterrestrial environments, such as the Moon, asteroids, or Mars, which may harbor microbial life or unique geological formations:

Ah-h, the worms, the Duke said. I must see one sometime. You may see one today, Kynes said. Wherever there is spice, there are worms. Always? Halleck asked. Always. Is there relationship between worm and spice? the Duke asked. Kynes turned and Paul saw the pursed lips as the man spoke. They defend spice sands. Each worm has a—territory. As to the spice… who knows? Worm specimens we've examined lead us to suspect complicated chemical interchanges within them (Herbert 1990, 32).

Throughout human history, the exploitation of natural resources has been a driving force behind societal development, economic growth, and technological advancement. However, this relentless pursuit of resources has often come at a significant cost to the planet's biodiversity. From the deforestation of ancient forests to the overhunting of species and the extraction of minerals, the overexploitation of natural resources has left an indelible mark on Earth's ecosystems. These historical patterns of resource extraction not only highlight humanity's dependence on the natural world but underscore the unintended consequences of prioritizing short-term gains over long-term ecological sustainability (Diamond 2011; Crosby 2004)..

The Industrial Revolution marked a turning point in the scale and intensity of resource exploitation, as technological advancements enabled the mass extraction of fossil fuels, timber, and minerals. This period saw the rapid decline of species and habitats as human activities began to outpace the regenerative capacity of ecosystems. Similarly, the colonization of new territories often led to the overexploitation of local resources, as seen in the near extinction of the North American bison and the deforestation of vast tracts of land in the tropics. These historical examples serve as cautionary tales, illustrating how the unchecked pursuit of resources can lead to irreversible biodiversity loss (Williams 2006; Grove 1996).

The global demand for resources has only intensified in the modern era, driven by population growth, urbanization, and consumerism. The consequences of this demand are evident in the ongoing sixth mass extinction, characterized by unprecedented rates of species decline and habitat destruction. As we stand on the brink of a new frontier—space mining—it is crucial to reflect on these historical patterns of resource exploitation and their impact on biodiversity. By understanding the past, we can better navigate the ethical and environmental challenges of the future, ensuring that the mistakes of history are not repeated on a cosmic scale (IPBES 2019).

This crisis has intensified due to the push for renewable energy.lix Minerals like lithium and cobalt, essential for batteries and electric vehicles, are being extracted at an alarming rate, often in biodiversity hotspots (North and Grinspun, 2016). Meanwhile, deep-sea mining threatens marine life in ways we barely understand, disrupting ecosystems that have existed undisturbed for millions of years (Van Dover et al. 2017). Beyond habitat destruction, mining also poisons water supplies, with toxic chemicals leaking into rivers and groundwater, devastating both wildlife and local communities (Damseth et al. 2024).lx

As the Earth's resources run low, companies and governments are turning to space, hoping to mine asteroids and the Moon for valuable minerals. While this sounds like a futuristic solution, space mining comes with serious risks—not just for space itself but also for our planet. Mining celestial bodies could permanently alter their surfaces and disturb potential extraterrestrial ecosystems, even if we don't fully understand their environmental significance yet (Newman & Clery, 2021). But the impact isn't just out there—every space mission requires rocket launches that release massive amounts of CO_2 and pollutants, worsening climate change and harming Earth's atmosphere (Levchenko et al., 2021).

Beyond environmental concerns, the race for space resources could spark geopolitical conflicts, much like colonial extractivism did in the past (Scheller & Arndt, 2022). Instead of learning from history, we may be repeating the same exploitative patterns—this time on a cosmic scale. If we're not careful, space mining could become just another extension of the destructive practices that have already devastated biodiversity on Earth (Rettberg et al. 2019). It is true that there is no hard evidence about how mining in space affects the environment, on Earth, and in space; however, considering the processes necessary to achieve it, the potential harms are related to rocket emissions, the production of space debris, and energy-intensive consumption and material to manufacture satellites.lxi lxii

V. FINAL REMARKS

This paper shows that science fiction stories reflect actual power relations and neo-extractivist inclinations, implying that space exploration, as now framed by international law, endangers repeating historical patterns of colonialism and exploitation. Examined via a postcolonial and TWAIL perspective, "Dune" reveals how the quest for resources, whether spice or minerals, can fuel imperial aspirations and marginalize native populations both on Earth and maybe in space., whether spice or minerals, can fuel imperial aspirations and marginalize native populations both on Earth and maybe in space. and TWAIL perspective, "Dune" reveals how the quest for resources, whether spice or minerals, can fuel imperial aspirations and marginalize native populations both on Earth and maybe in space., whether spice or minerals, can fuel imperial aspirations and marginalize native populations both on Earth and maybe in space.

The future of space governance is greatly affected by the findings of this research. It calls for a critical re-evaluation of international space law to correct its natural prejudices and guarantee fair access to space resources. To create frameworks that prioritize sustainability, inclusiveness, and justice in space exploration, there must be interdisciplinary conversation combining postcolonial viewpoints, environmental ethics, and legal theory. The results imply that space exploration could aggravate and continue current environmental damage and inequalities without such a vital rethinking. Future studies might widen the scope to cover various literary works, especially those from non-Western heritages, to investigate, for instance, China's space project.

The analysis shows that Dune offers a complex critique of interstellar feudal capitalism by showing how the imperial drive works through both open violence and the manipulation of legal and religious systems. From a Marxist point of view, the change of control of Arrakis from the Harkonnens to the Atreides is not a

move from evil to good but a change in the way the ruling class produces the spice. This arrangement is similar to the Bretton Woods development model, where the Global South is structurally exploited by moving administrative power around while the extraction of natural resources stays the same and is not sustainable. The gift of the planet by the Padishah Emperor is a form of primitive accumulation happening legally, justifying taking away indigenous sovereignty in the name of imperial mandate.

From a TWAIL perspective, the interactions between the Atreides family and the Fremen illustrate the intricate politics of colonial legitimacy and resistance. Lady Jessica's use of the Missionaria Protectiva status shows how imperial powers send ideological tools to the edges of their empires to get people to agree before the colonizer even gets there. This early colonization of the mind leads to Paul Atreides being accepted as a predicted leader, the Messiah, and turns native resistance into a means for him to rise to power. Therefore, the text tells a cautionary tale about the morals of relationships between people from different cultures and species, where the liberator often strengthens the very power structures and cultural hierarchies they say they are against.

Finally, the conversations and interactions with nature in the book give readers a chance to think about the effects of exploration driven by resources and the legacies of the past. The Fremen's use of unconventional warfare and their deep knowledge of the arid planet Arrakis show that they have power that challenges the empire's technological superiority. But when an elite revolutionary vanguard takes over these native struggles, it often leads to a cosmic version of the imperial drive, as shown by Paul's transformation into Muad'Dib. The manuscript connects the made-up fight for spice to current debates about the legality and morality of space mining by looking at these internal politics, showing that the desire to control resources is still a major, often apathetic, force in both science fiction and real-world international relations.

Ultimately, this paper emphasizes the need to analyze the stories and legal systems forming space exploration carefully. It warns against uncritically extending terrestrial patterns of exploitation into space by exposing the similarities between colonial history and modern space aspirations. The combination of postcolonial theory, Marxism, and TWAIL provides a useful perspective for interrogating and comprehending the imperialist logic ingrained in present space governance. In the end, the research promotes a more ethical and reflexive method of space exploration that draws on past errors to support a fair and sustainable future for all.

REFERENCES

1. Acosta, Alberto, Ulrich Brand, Hugo Albuquerque, Manuela Beloni, Tadeu Breda, Bianca Oliveira, Laura Massunari, and Célia Massis. 2018. *Pós-extrativismo e Decrescimento: Saídas do Labirinto Capitalista*. Edited by Caue Seignemartin Ameni. 1ª edição. Autonomia Literária.
2. Adar, Perpetua Akoth. 2022. "Space and the Future of Humanity: A TWAIL Critique of International Space Law and Space Discourse." TWAILR. December 6, 2022. https://twailr.com/twail-review/issue-03-2022/perpetua-akoth-adar-space-and-the-future-of-humanity-a-twail-critique-of-international-space-law-and-space-discourse/.
3. Albrecht, Milton C. 1954. "The Relationship of Literature and Society." *American Journal of Sociology* 59 (5): 425–36. https://doi.org/10.1086/221388.
4. Ali, Saleem H. 2014. *Treasures of the Earth: Need, Greed, and a Sustainable Future*. New Haven: Yale University Press.
5. Althusser, Louis. 2014. *On the Reproduction of Capitalism: Ideology and Ideological State Apparatuses*. London ; New York: Verso Books.
6. Anghie, Antony. 2007. *Imperialism, Sovereignty and the Making of International Law*. 1 edition. Cambridge, UK ; New York: Cambridge University Press.
7. ———. 2024. "Rethinking International Law: A TWAIL Retrospective - EJIL." 2024. http://www.ejil.org/article.php?article=3315&issue=163.
8. Ashcroft, Bill. 2020. "Postcolonial Science Fiction and the Ethics of Empire." In *Ethical Futures and Global Science Fiction*, edited by Zachary Kendal, Aisling Smith, Giulia Champion, and Andrew Milner, 165–85. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-27893-9_8.
9. Banerjee, Suparno. 2022. "Reverse Colonization: Science Fiction, Imperial Fantasy, and Alt-Victimhood by David M. Higgins (Review)." *Science Fiction Studies* 49 (3): 564–68.
10. Bebbington, Anthony, Teresa Bornschlegl, and Adrienne Johnson. 2018. "Political Economies of Extractive Industry: From Documenting Complexity to Informing Current Debates." *Development and Change* n/a (n/a). https://doi.org/10.1111/dech.12057.

11. Brady, Henry, and David Collier. 2010. *Rethinking Social Inquiry: Diverse Tools, Shared Standards*. Second Edition. Rowman & Littlefield Publishers.
12. Brand, Ulrich, and Markus Wissen. 2021. *The Imperial Mode of Living: Everyday Life and the Ecological Crisis of Capitalism*. London New York: Verso.
13. Chanda, Nayan. 2007. *Bound Together: How Traders, Preachers, Adventurers, and Warriors Shaped Globalization*. 1 edition. New Haven: Yale University Press.
14. Crosby, Alfred W. W. 2004. *Ecological Imperialism 2ed: The Biological Expansion of Europe, 900-1900*. 2nd edition. Cambridge: Cambridge University Press.
15. Dabelko, Geoffrey D., Mike Brklacich, May Chazan, Hans Georg Bohle, Laura Little, Chris Cocklin, Victoria Basolo, et al. 2009. *Global Environmental Change and Human Security*. Edited by Richard A. Matthew, Jon Barnett, Bryan McDonald, and Karen L. O'Brien. Cambridge, Mass: The MIT Press.
16. Damseth, Sourav, Kushal Thakur, Rakesh Kumar, Sunil Kumar, Danish Mahajan, Hishani Kumari, Dixit Sharma, and Amit Kumar Sharma. 2024. "Assessing the Impacts of River Bed Mining on Aquatic Ecosystems: A Critical Review of Effects on Water Quality and Biodiversity." *HydroResearch* 7 (January):122–30. https://doi.org/10.1016/j.hydres.2024.01.004.
17. Decker, Kevin S., and Jason T. Eberl, eds. 2008. *Star Trek and Philosophy: The Wrath of Kant*. First Edition. Chicago, Ill: Open Court.
18. Deudney, Daniel. 2020. *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity*. Oxford: Oxford University Press.
19. Diamond, Jared. 2011. *Collapse: How Societies Choose to Fail or Succeed: Revised Edition*. Revised edition. New York: Penguin Books.
20. Drage, Eleanor. 2022. "Imperialism's Performative Technologies: Race, Gender, and Wearable Devices in Aliette de Bodard's 'Immersion.'" In *Performing Cultures of Equality*. Routledge.
21. Drezner, Daniel W. 2024. "How Everything Became National Security." *Foreign Affairs*, August 12, 2024. https://www.foreignaffairs.com/united-states/how-everything-became-national-security-drezner.
22. Ekelund, Robert B. 1982. *Mercantilism As a Rent-Seeking Society: Economic Regulation in Historical Perspective*. First Edition. College Station, Tex: Texas A & M Univ Pr.
23. Escobar, Arturo. 2011. *Encountering Development: The Making and Unmaking of the Third World*. Edição: With a New preface by the author. Princeton, N.J: Princeton University Press.
24. Fisher, Mark. 2009. *Capitalist Realism: Is There No Alternative?* Winchester, UK Washington, USA: Zero Books.
25. Freeman, Carla P. 2020. "An Uncommon Approach to the Global Commons: Interpreting China's Divergent Positions on Maritime and Outer Space Governance." *China Quarterly* 2020:1.
26. Galeano, Eduardo, and Isabel Allende. 1997. *Open Veins of Latin America: Five Centuries of the Pillage of a Continent*. Anniversary edition. New York: Monthly Review Press.
27. George, Alexander L., and Andrew Bennett. 2005. *Case Studies and Theory Development in the Social Sciences*. The MIT Press.
28. Gernsback, Hugo. 2016. *The Perversity of Things: Hugo Gernsback on Media, Tinkering, and Scientifiction*. Edited by Grant Wythoff. Univ Of Minnesota Press.
29. Goldstein, Yossi. 2018. "The Six Day War: The War That No One Wanted." *Israel Affairs* 24 (5): 767–84. https://doi.org/10.1080/13537121.2018.1505475.
30. Gómez-Barris, Macarena. 2017. *The Extractive Zone: Social Ecologies and Decolonial Perspectives*. Durham ; London: Duke University Press Books.
31. Grove, Richard H. 1996. *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860*. Cambridge: Cambridge University Press.
32. Gunderson, Ryan, Diana Stuart, and Brian Petersen. 2021. "In Search of Plan(et) B: Irrational Rationality, Capitalist Realism, and Space Colonization." *Futures* 134 (December):102857. https://doi.org/10.1016/j.futures.2021.102857.
33. Harding, Sandra. 2004. "Postcolonial Science and Technology Studies: A Space for New Questions." In *Postcolonlsm*. Routledge.
34. Herbert, Frank. 1990. *Dune*. New York: Ace.
35. Hickel, Jason. 2020. *Less Is More: How Degrowth Will Save the World*. London: William Heinemann.
36. ———. 2021. "The Anti-Colonial Politics of Degrowth." *Political Geography* 88 (June):102404. https://doi.org/10.1016/j.polgeo.2021.102404.
37. Hoagland, Ericka, and Reema Sarwal. 2010. *Science Fiction, Imperialism and the Third World: Essays on Postcolonial Literature and Film*. 1st edition. McFarland.
38. Horkheimer, Max, and Theodor W. Adorno. 2007. *Dialectic of Enlightenment*. Edited by Gunzelin Schmid Noerr. Translated by Edmund Jephcott. 1 edition. Stanford, Calif: Stanford University Press.

39. Huesemann, Michael, and Joyce Huesemann. 2011. *Techno-Fix: Why Technology Won't Save Us or the Environment*. Gabriola Island, B.C: New Society Publishers.
40. IPBES. 2019. "Global Assessment Report on Biodiversity and Ecosystem Services." May 17, 2019. https://www.ipbes.net/node/35274.
41. James, Edward, and Farah Mendlesohn, eds. 2003. *The Cambridge Companion to Science Fiction*. Cambridge Companions to Literature. Cambridge: Cambridge University Press. https://doi.org/10.1017/CCOL0521816262.
42. Jansen, Jan C., and Jürgen Osterhammel. 2019. *Decolonization: A Short History*. Translated by Jeremiah Riemer. Reprint edition. Princeton Oxford: Princeton University Press.
43. Kinnaman, Thomas C. 2023. "A New Perspective on the Natural Resource Curse." *World* 4 (4): 670–83. https://doi.org/10.3390/world4040042.
44. Klein, John J. 2020. *Understanding Space Strategy*. 1st edition. Routledge.
45. Langer, J. 2011. *Postcolonialism and Science Fiction*. 1st ed. 2011 edition. Basingstoke, Hampshire: Palgrave Macmillan.
46. Liu, Cixin. 2016. *The Three-Body Problem*. Translated by Ken Liu. Reprint edition. New York: Tor Books.
47. Lyotard, Jean-Francois, and Fredric Jameson. 1984. *The Postmodern Condition: A Report on Knowledge*. Translated by Geoff Bennington and Brian Massumi. 1st edition. Minneapolis: University Of Minnesota Press.
48. Marcuse, Herbert, and Douglas Kellner. 2012. *One-Dimensional Man: Studies in the Ideology of Advanced Industrial Society*. 2nd edition. Beacon Press.
49. Marshall, Alan. 1995. "Development and Imperialism in Space." *Space Policy* 11 (1): 41–52. https://doi.org/10.1016/0265-9646(95)93233-B.
50. Martins Simoneti, Caio A. 2022. "'More Human than Human': Colonial Logics and the Modern Subject in Science Fiction Films." *Millennium* 51 (1): 184–211. https://doi.org/10.1177/03058298221128069.
51. Mattei, Ugo, and Laura Nader. 2008. *Plunder: When the Rule of Law Is Illegal*. 1st edition. Malden, Mass: Wiley-Blackwell.
52. McKagen, E. Leigh. 2018. "'To Boldly Go!': Adventure and Empire in Star Trek." *Imperial & Global Forum* (blog). June 14, 2018. https://imperialglobalexeter.com/2018/06/14/to-boldly-go-adventure-and-empire-in-star-trek/.
53. McNelly, Willis. 1984. "The Complete Authorized Guide and Companion to Frank Herbert's Masterpiece of the Imagination, the Dune Encyclopedia:" 1984. https://www.amazon.com/Authorized-Companion-Masterpiece-Imagination-Encyclopedia/dp/B000H7O084/ref=sr_1_4?crid=3P13IZLP81T1B&dib=eyJ2IjoiMSJ9.ZWxPm-luRt_H_2__fkNSzL-fhmDa1W8aiaqgWmPsrJhdVmTiXuOsBX4nILEBr_52o1qMdD0r_1Ydr5txLYbX8RS5N_ZUwxRPAe8kUZvvKiicWf3M5z46vD0CIkPnt5evm-_DkvolonRFuAkxbHTZMUc4I5nuijzlyvAvq4R2C8E.RVigMBjmG6_sKrUvsh_aSF5SsndIYKdRmY2VDH1UzzQ&dib_tag=se&keywords=dune+encyclopedia+mcnelly&qid=1723705573&sprefix=dune+encyclopedia+mcnelly%2Caps%2C563&sr=8-4.
54. Montague, P., and M. B. Pellerano. 2024. "History of the US Environmental Movement." In *Encyclopedia of Toxicology (Fourth Edition)*, edited by Philip Wexler, 303–32. Oxford: Academic Press. https://doi.org/10.1016/B978-0-12-824315-2.00409-7.
55. Muszyński-Sulima, Wawrzyniec. 2023. "Cold War in Space: Reconnaissance Satellites and US-Soviet Security Competition." *European Journal of American Studies* 18 (2). https://doi.org/10.4000/ejas.20427.
56. Mutua, Makau, and Antony Anghie. 2000. "What Is TWAIL?" *Proceedings of the Annual Meeting (American Society of International Law)* 94:31–40.
57. North, Liisa L., and Ricardo Grinspun. 2016. "Neo-Extractivism and the New Latin American Developmentalism: The Missing Piece of Rural Transformation." *Third World Quarterly*, August. https://www.tandfonline.com/doi/abs/10.1080/01436597.2016.1159508.
58. Pankova, Lyudmila V. 2021. "Competition in Space: Opportunities, Consequences and Risks to International Security" 2318. https://doi.org/10.1063/5.0035827.
59. Relations, E.-International. 2015. *Popular Culture and World Politics: Theories, Methods, Pedagogies*. Edited by Federica Caso and Caitlin Hamilton. E-International Relations.
60. Rettberg, Petra, André Antunes, John Brucato, Patricia Cabezas, Geoffrey Collins, Alissa Haddaji, Gerhard Kminek, et al. 2019. "Biological Contamination Prevention for Outer Solar System Moons of Astrobiological Interest: What Do We Need to Know?" *Astrobiology* 19 (8): 951–74. https://doi.org/10.1089/ast.2018.1996.
61. Rodney, Walter, and Angela Davis. 2018. *How Europe Underdeveloped Africa*. Verso.
62. Said, Edward W. 1994. *Culture and Imperialism*. Reprint edition. New York: Vintage.
63. Seed, David. 2010. "The Course of Empire: A Survey of the Imperial Theme in Early Anglophone Science Fiction." *Science Fiction Studies* 37 (2): 230–52.

64. Sgobba, Tommaso, and Mini Gupta. 2022. "Proposing an International Convention for an Intermediate Region between Airspace and Outer Space Instead of the 'Karman Line.'" *Journal of Space Safety Engineering* 9 (2): 127–28. https://doi.org/10.1016/j.jsse.2022.05.003.
65. Surhone, Lambert M., Miriam T. Timpledon, and Susan F. Marseken, eds. 2010. *New World Order (politics): Balance of Power in International Relations, Global Governance, Woodrow Wilson, Fourteen Points, League of Nations, Bretton Woods System, Great Power*. Betascript Publishers.
66. Svampa, Maristella. 2022. "Extractivism and Neo-Extractivism." In *Handbook of Critical Environmental Politics*, 270–81. Edward Elgar Publishing. https://www.elgaronline.com/edcollchap/book/9781839100673/book-part-9781839100673-27.xml.
67. Transnational Institute. 2024. "Beyond Development." February 21, 2024. https://www.tni.org/en/publication/beyond-development.
68. Van Dover, C. L., J. A. Ardron, E. Escobar, M. Gianni, K. M. Gjerde, A. Jaeckel, D. O. B. Jones, et al. 2017. "Biodiversity Loss from Deep-Sea Mining." *Nature Geoscience* 10 (7): 464–65. https://doi.org/10.1038/ngeo2983.
69. Varoufakis, Yanis. 2023. "Technofeudalism: What Killed Capitalism." 2023. https://www.amazon.com/Technofeudalism-Killed-Capitalism-Yanis-Varoufakis/dp/1685891241.
70. Wallerstein, Immanuel. 2006. *European Universalism: The Rhetoric of Power*. 1st edition. New York: New Press.
71. Weiner, Robert G. 2009. *Captain America and the Struggle of the Superhero: Critical Essays*. New edition. Jefferson, N.C: MCFARLAND & CO INC.
72. Williams, Michael. 2006. *Deforesting the Earth: From Prehistory to Global Crisis, An Abridgment*. Abridged edition. Chicago: University of Chicago Press.
73. Yacine, Barka Rabeh, and Ahmad Y. Majdoubeh. 2023. "Reimagining Colonialism: Dune Within Postcolonial Science-Fiction." *Theory and Practice in Language Studies* 13 (2): 501–7. https://doi.org/10.17507/tpls.1302.27.
74. Young, Robert J. C. 2001. *Postcolonialism: An Historical Introduction*. 1 edition. Oxford, UK ; Malden, Mass: Wiley-Blackwell.
75. ———. 2003. *Postcolonialism: A Very Short Introduction*. 1 edition. Oxford ; New York: Oxford University Press.

[i] The propagation can be exerted in any literature. A representation of this phenomenon, for instance, in the creation of the comic book Captain America during the Second World War; the cover of edition number one shows Captain America, dressed in blue, red, and white star suit, punching Hitler in the face. Later editions show Captain America combating the Japanese and socialism (Weiner, 2009). This trend is confirmed by McKagen (2018, p.2): "Through the codependence on adventure and technology, Star Trek reinforces an empire that exists without features of conquest seen in much historical imperialism. The narrative of empire in Star Trek is rooted in historical imperial power relations that continue into the present, and are projected far into the future."

[iii] There are several points of debate in academia about what constitutes the science fiction genre. For our study, Dune is an SF because it encapsulates the "sense of wonder" as theorized by James & Mendlesohn (2003). In other words, since the publication of the book in 1965, the "sense of wonder" has decreased (space mining or space neo-extractivism (the term is explained later in note 6), for instance); it still possesses a certain degree of imagination that has not been fulfilled.

[iv] Non-Western SF works are excluded for comparative purposes as it is not the objective of this work. However, it is important to note that in future research, the works of N.K. Jemish, Liu Cixin, and China Miéville offer alternative perspectives.

[ix] Neo-extractivism refers to conflicts arising from the expansion of extractive industries, which possess specific characteristics, such as state involvement and redistribution, economic diversification attempts, continued dependency on global markets, response to global demands, sustainable development claims, and social and environmental conflicts (Transnational Institute, 2024).

[xi] There is no universally recognized legal definition or threshold to determine the commencement of outer space. Several suggestions have been put up, but the countries have unanimously embraced none. The Karman Line is the widely recognized boundary that marks the start of outer space. It is situated around 100 kilometers (62 miles) above sea level. The Fédération Aéronautique Internationale (FAI), an international organization responsible for establishing standards and recording achievements in aeronautics and astronautics, employs this definition. Although the Karman Line is not legally enforceable under international treaties, it is a widely accepted boundary (Sgobba & Gupta, 2022).

[xii] See https://www.unoosa.org/oosa/en/ourwork/copuos/index.html#:~:text=The%20Committee%20on%20the%20Peaceful,for%20peace%2C%20security%20and%20development. Last access: April 25, 2025.

[xiii] About the general aspects and advantages of launching rockets from the Equatorial coordinates, see: https://forum.nasaspaceflight.com/index.php?topic=39184.0. Last Access: April 25, 2025.

[xv] As indicated in the Introduction of this study, the Bretton Woods institutions have not responded to the challenges, especially considering the expectations of the developing countries regarding economic and environmental security, leading to the existential threat we live in today (Dabelko et al., 2009). International institutions in the aftermath of the Second World War made clear that the systematic control over the natural resources needed to continue under the imperative of GDP growth, which includes space exploration because of the physical limitations of the Earth.

[xvi] This is transpired by the United States National Space Strategy: "The United States Trade Representative (USTR) is primarily responsible for international trade agreements to which the United States is a party. USTR, in consultation with other relevant heads of agencies, will lead any effort relating to negotiating and implementing trade disciplines governing trade in goods and services related to space (p.22). In https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Space-Policy.pdf. Last Access: April 25, 2025.

[xvii] See https://www.nasa.gov/artemis-accords/. Last Access: April 25, 2025.

[xviii] In the *Fact Sheet: Artemis Accords – United for Peaceful Exploration of Deep Space* at https://br.usembassy.gov/fact-sheet-artemis-accords-united-for-peaceful-exploration-of-deep-space/. Last Access: April 25, 2025.

[xix] See the contracts awarded to SpaceX at https://www.usaspending.gov/search?hash=f7339aa890885cfcbaad59f0a4e96424. Last Access: April 25, 2025.

[xx] See https://undark.org/2024/05/08/asteroid-mining-space-metals/. Last Access: April 25, 2025.

[xxi] In https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/12/National-Space-Policy.pdf. Last Access: April 25, 2025.

[xxiii] See Kaul (2024), which is related to the discussion about space as a global common.

[xxiv] See https://swfound.org/media/205451/2016-msimpson-sdgs-and-space-resources-leiden-04172016.pdf. Last Access: April 25, 2025.

[xxv] See https://www.milkenreview.org/articles/mining-in-space-is-coming.Last Access: April 25, 2025.

[xxvi] The use of ideology in SF and other fictional pieces is a potent yet subtle tool for reproducing the capitalist logic of production and accumulation. In this sense, take, for example, the logic behind Captain America's comic books and movies vis-à-vis the historical locus in which the United States was experiencing, to the extent that the "[…] repeated use of language and signs continually influences the audience to believe in Captain America and his liberal ideology, as he is reinforcing the idea of freedom and supporting the military (who are an RSA). Nonetheless, Ideology is more than the signifiers I am identifying, it involves the "relations between these signs and processes of political power" Eagleton (1991)." In https://medium.com/@s5062669/captain-america-ideology-and-canon-a-textual-analysis-871c7110e86e. See also: Lenin and Philosophy" and Other Essays by Louis Althusser in https://www.marxists.org/reference/archive/althusser/1970/ideology.htm. Last Access: April 25, 2025.

[xxvii] In The racist language of space exploration | The Outline. Last Access: April 25, 2025.

[xxxiv] In https://www.nasa.gov/humans-in-space/nasa-awards-spacex-more-crew-flights-to-space-station/?. Last Access: April 25, 2025.

[xxxvi] This aspect is related to technofeudalism, a critical viewpoint that describes the current phase of capitalism, characterized by the supremacy of a small number of giant technology corporations. This term combines the concepts of technological dominance and authority with feudalism, a socio-economic structure in which a privileged minority possesses substantial control over resources and political influence. At the same time, the bulk are akin to vassals or serfs (Varoufakis, 2023).

[xxxviii] "Historians have made big strides in understanding how the rise of capitalism depended on enclosure. But too often this story ignores the patterns of primitive accumulation that were playing out at the same time beyond Europe's shores, as part of the very same process. Across the global South, nature and human bodies were enclosed to an extent that dwarfed what happened within Europe itself. When Europeans began to colonise the Americas in the decades after 1492, they were not driven by the romance of 'exploration' and 'discovery', as our schoolbooks would have it. Colonisation was a response to the crisis of elite disaccumulation that had been caused by the peasant revolutions in Europe. It was a 'fix'. Just as elites turned to enclosure at home, they sought new frontiers for accumulation abroad." (Hickel, 2020, p.67).

[xxxix] "Behind the early colonial efforts of the European powers lay the need to finance the tremendous economic necessity of the newborn centralized systems of government, essential for capitalist development to happen. Without gold, silver, cotton, and human beings coming from faraway lands, it would have been impossible to finance the institutional system that eventually paved the way to industrialization and development" (Mattei & Nader, 2008, p.21).

[xlii] The resistance embedded in the Cocoyoc Declaration (1974) represents this trend within Western international institutions regarding developing countries: "Consequently, we emphasize the need for pursuing many different roads of development. We reject the unilinear view which sees development essentially and inevitably as the effort to imitate the historical model of the countries that for various reasons happen to be rich today. For this reason, we reject the concept of "gaps" in development. The goal is not to "catch up" but to ensure the quality of life for all with a productive base compatible with the needs of future generations." In https://digitallibrary.un.org/record/838843?v=pdf. Last Access: April 25, 2025.

[xliv] For instance, when the disruptions caused by the Fremens threaten the flow of spice and the inefficiency of the Harkonnens to control them, the Emperor, as the guarantor of law and order in the universe, steps in with his mighty army. In the movie version of Dune in 1984, there is an utterance by the Emperor (not found in the book) referring to going after the Fremens to ensure the flow of spice: "This is genocide: the deliberate and systematic destruction of all life in Arrakis." The relationship between the state and transnational corporations is historical as reported by Chanda (2007).

[xlvi] In https://www.statista.com/statistics/745717/global-governmental-spending-on-space-programs-leading-countries/. Last Access: April 25, 2025.

[xlvii] In https://www.thespacereview.com/article/4955/1. Last Access: April 25, 2025.

[xlviii] In https://tanaka-preciousmetals.com/en/elements/news-cred-20220711/. Last Access: April 25, 2025

[l] In https://www.space.com/space-exploration/tech/asteroid-mining-company-astroforge-gets-1st-ever-fcc-license-for-commercial-deep-space-mission. Last Access: April 25, 2025.

[liv] This pattern produces direct implications for the environmental justice dimension. To that extent, there is already a disproportionate burden of environmental degradation and resource extraction on marginalized communities. The primary driver of space mining is to fuel further technological advancement and consumption patterns in already industrialized nations, the environmental costs associated with these activities, both on Earth (e.g., manufacturing, launches) and potentially in space, might disproportionately impact vulnerable populations who have contributed least to the demand for these resources. Furthermore, decisions about resource allocation and the environmental regulations (or lack thereof) in space could be made without equitable representation, mirroring historical patterns of environmental injustice on Earth, where marginalized voices are often excluded from decision-making processes regarding resource management and pollution. See for instance: https://hir.harvard.edu/economics-of-the-stars/, and https://fastercapital.com/content/Asteroid-Mining--From-Resources-to-Potential-Risks-of-an-Event.html. Last Access: April 25, 2025.

[lvii] China is a representative instance of resistance to the current space exploration model. Regarding investments, China is the second largest investor in space programs, with US$14.15 billion (www.statista.com). As it happens in other international regimes, China is positioning itself to reconfigure said regimes to be more inclusive, incorporating non-Western positions (Freeman, 2020).

[lviii] The commodities boom provided the economic structure that sustained the so-called Pink Tide in Latin America and other parts of the world. It denotes the ascendance and eventual decline of leftist administrations in Latin America, encountering obstacles in societal advancement, economic growth, and regional integration. See Kurlandt, P. (2023). The fall of the pink tide: Lessons for the contemporary left. *Ameryka Łacińska. Kwartalnik Analityczno-Informacyjny*, *31*(1 (119)), 51–72. https://doi.org/10.7311/20811152.2023.119.03

[lix] See https://www.unep-wcmc.org/en/news/the-green-energy-transition-and-mining. Last access: April 24, 2025.

[lx] See https://www.wri.org/insights/how-mining-impacts-forests. Last access: April 24, 2025.

[lxi] See https://www.mindsprint.in/blog/environmental-impact-of-space-exploration, and https://interconnectedrisks.org/2023/tipping-points/space-debris#:~:text=Each%20piece%20of%20debris%20becomes,functional%20satellites%20to%20avoid%20collisions. Last access: April 25, 2025.