Mariana Silva

Mining the Deep Sea

Later this year, a new legal code that regulates seabed mining in international waters will be adopted by 167 countries. Issued by the International Seabed Authority, a United Nations organization, this code will regulate the exploitation of minerals such as manganese, cobalt, gold, copper, iron, and other rare earth elements for commercial purposes. It follows thiry previous agreements on prospective exploration with which countries have been allowed to survey their allocated territory to take stock of potential mineral riches, covering 1.3 million square kilometers of the ocean floor.[1] Until now, companies and states have only been able to survey and explore the territories they lease, but this new provision paves the way for future forms of commercial extraction.

The prospect of mining the ocean seabed in the high seas is just that for now: a prospect. But the developments of deep sea mining in the coming years might be an exemplary case of what happens on the eve of the opening of a new capitalist frontier to sustain the mineral commodity market, which has been growing for the past two decades. Once the 2020 mining code goes into effect, it is very possible that a deep sea mining industry may snap into place across national and international waters, since the international mining code will likely serve as a template that nation-states can adapt within their own territorial waters. For over a decade, certain countries have been strategizing to insure they are geopolitically well positioned when the mining code finally comes into effect.[2]

Ultimately, whether an underwater industry will bloom will depend on a few other favorable variables such as: bigger market demand and consistent rise in mineral prices; on-land scarcity or geopolitical tensions preventing access to resources; viable and cost-efficient extraction and processing technology; favorable national legislation; interest from the scientific community in accessing mining sites for research purposes; and a lack of opposition from civil society at the national and international levels. Calls for a ten-year moratorium on mining have been made by many environmental NGOs, the European Parliament, and more recently the Pacific island-states of Fiji and Vanuatu, after the disastrous bankruptcy of a high-stakes concession that left Papua New Guinea $125 million in debt.[3] Determining cross-national forms of protesting deep sea mining in national and international waters might be informative for future climate protests and blockades, where, as is the case with deep sea mining, resistance cannot happen on-site.

The Pacific, Atlantic, Arctic, and Indian oceans share common geomorphologies, shaped by spreading ridges and convergent plate

e-flux journal #109 — may 2020 Mariana Silva
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boundaries. These contain three types of geological sites set to be mined. The first are massive sulfide deposits located in hydrothermal vents that result from the thermal and chemical reactions of underwater volcanic activity. The second are cobalt-rich ferromanganese crusts deposited around volcanic configurations such as seamounts, ridges, and plateaus. The third are tennis-ball-shaped polymetallic nodules located in various geomorphologies. These comprise the main geological formations in international waters targeted for exploration in the Mid-Atlantic Ridge and the Clarion Clipperton Zone (Pacific Ocean) and in the national waters of Papua New Guinea, Fiji, Tonga, New Zealand, Japan, and the Portuguese Azores archipelago.

This text is born from many conversations and collective research conducted by Pedro Neves Marques, Margarida Mendes, and myself – operating collectively as Inhabitants – over a two-year period while developing an ongoing web series titled *What is Deep Sea Mining?*, which seeks to address some of our main concerns with the practice. This essay responds to some of the pro–deep sea mining arguments we've had to contend with and some anti–deep sea mining arguments that are circulating. It asks whether foregrounding the history of biology and geology can help question the discussions that extractive capitalism will attempt to mobilize. It tries to contextualize how these discussions operate within recent developments of biopower under capitalism.

Microscopic Mythologies

In 1977, scientists onboard the American submersible *Alvin* encountered what they called "black smokers," or hydrothermal vents off the coast of the Galápagos. At the time it was the first recorded encounter with hydrothermal vents, and they could not have predicted the parallels between their own discovery and Charles Darwin's famous Galápagos discoveries of the 1830s. The towering volcanic vents resemble chimneys that can rise to forty-five meters high. They are the result of the precipitation of magma-heated minerals in the high pressure of the cold ocean environment. To the scientists' surprise, despite the fact that these environments can reach temperatures of up to 400 degrees Celsius, unique ecosystems with mollusks, gastropods, tube-dwelling worms, sea anemones, and crustaceans could be found in them. Even more surprisingly, scientists were soon to find that at the nutritional basis of this food chain were microorganisms that use hydrogen sulphide as energy in a process called chemosynthesis.[4]

The Galápagos Islands were visited by Darwin in 1835 and have been credited as the site where the British naturalist first realized that species might evolve – mutate in time and space across island geographies. The 1859 publication of *On the Origin of Species by Means of Natural Selection* inaugurated a genealogical focus on evolution, based on an evolutionary tree branching from the principal cellular life-forms of bacteria and eukaryota. Knowledge of hydrothermal vents has contributed to the discovery of a third domain of microbial life to populate the Darwinian tree: archaea. Scientists have claimed that

> [there] are striking parallels between the chemistry of the H(2)-CO(2) redox couple that is present in hydrothermal systems and the core energy metabolic reactions of some modern prokaryotic autotrophs. The biochemistry of these autotrophs might, in turn, harbour clues about the kinds of reactions that initiated the chemistry of life. Hydrothermal vents thus unite microbiology and geology to breathe new life into research into one of biology's most important questions: what is at the origin of life?[5]

As narrated by anthropologist Stefan Helmreich, Darwisnism's genealogical predilection was taken up by genetics, the study of DNA and its cellular reproduction, throughout the twentieth century. This was undertaken firstly through the rewriting of the evolutionary tree based on phylogenetics, then through the analysis of ribosomal RNA (rRNA) genes. It is through analysis of ribosomal RNA that scientists have arrived at the belief that archaea are – as their name suggests – archaic beings that predate other single-celled life-forms.[6] Yet, archaea also exhibit lateral or horizontal gene transfer, which is the "nonsexual transmission of genetic material between unrelated genomes [and] across species boundaries," is estimated to account for a percentage of archaea's genomes.[7] Some scientists claim this process may undermine current research into a last common ancestor in order to find "what is at the origin of life." Horizontal gene transfer complicates phylogenetics and genealogical readings of genetics that have emphasized vertical reproduction – the passing down of genes instead of a sideways transmission. Ultimately, the identification of horizontal gene transfer is currently making the assessment of genetic ancestry more difficult and undermining the very representation of evolutionary trees, which have been a benchmark since Darwin.

Bioprospecting is the search for living species that may contain pharmaceutical or otherwise commercially valuable chemical compounds. Less than two decades after hydrothermal vents were discovered, a DNA polymerase isolated from the bioprospected archael hyperthermophile of the *Pyrococcus* genus was put on sale as the DeepVent® enzyme.[8] DeepVent® started to be used in gene amplification, "since enzymes from [hyperthermophilic] creatures can be used to make biochemical reactions run hotter and faster." It is also applied in molecular biology laboratories in polymerase chain reactions (PCR) to facilitate the copying of DNA.[9] Today, PCR is used in genetic testing for the analysis of ancient samples of DNA and the identification of infectious agents, with broader biomedical and criminal forensic applications.[10] In 1995, *Methanococcus jannaschii,* a protein found in many single-celled archea that thrive in the extremely hot hydrothermal vents, became the third genome to ever be sequenced and revealed a capacity to withstand temperatures around which most proteins "denature." Perhaps these discoveries provide a contemporary version of a Jules Verne tale: DeepVent® polymerase, a patented enzyme from the deep sea, provides the medium for cutting-edge technology and genetic research; *Methanococcus jannaschii* reveals "alien" genes previously unknown to scientists.

In the West, exploration of the deep sea has historically conjured images of ancient monstrous mythological creatures such as the Leviathan, the Kraken, and more recently the Cthulhu, among other figures of alterity and the unknown. Characterized by scientists and mainstream media alike for being "utterly alien," newly discovered undersea life-forms are no longer gigantic, but microbial. Descriptions often mix in themes of outer space exploration in the evocation of the "alien" and the technical challenges of building robotics to withstand extreme underwater pressure conditions. Perhaps the recent reconception of evolutionary trees prompted by underwater hydrothermal vents, over a century after the initial Western exploration of the Galápagos, contributes to a particular form of modern mythology – a science-led search for a last common ancestor of sorts fueled by biogenetic labs.

On the other hand, while hydrothermal vents are numerously located at the spreading ridges and convergent plate boundaries of the mid-oceanic ridge systems in the Pacific, Atlantic, Arctic, and Indian oceans, only about ten percent of deep-ridge habitats have been studied. Therefore, the consequences of deep sea mining on the environments they will exploit are vastly unknown and difficult to assess. This is because it is hard to calculate the consequences of the toxic debris expelled by potential vessels involved in deep sea mining and how the debris might spread through ocean currents. Furthermore, the metabolisms of deep sea organisms are notoriously slow and it is unknown how they might react to this new type of debris and the scale at which it might occur. Finally, baseline assessments are hard to confidently conclude amidst ocean acidification and climate change, when so many of these relations require further study themselves.

Underwater Geontopower

In 2004, New Zealand issued the Foreshore and Seabed Act, which allowed for the Trans-Tasman Resources company to legally propose a seabed mine that would seek to extract 50 million tons of seabed to exploit iron and titanium magnate.[11] This led to a fifteen-year campaign that culminated in a legal challenge brought against New Zealand's Environmental Protection Agency (EPA) by diverse groups such as Kiwis Against Seabed Mining, Greenpeace, the Māori tribes Ngāti Ruanui and Ngā Rauru, the environmental organization Forest and Bird, commercial fishing organizations, and the Taranaki-Whanganui Conservation Board. In the final ruling issued in early 2020, New Zealand's EPA was required to consider the "full range of customary rights, interests and activities identified by Māori as being affected by the TTR proposal."[12] Although the situtation pertains to areas in shallow waters off the coast and thus is not technically deep sea mining, for geographer Katherine G. Sammler it highlights how "the very division of territory and property along a land/sea binary" common both to the Crown and ocean law brings to the fore complex ontological discussions relevant to the deep sea. Sammler writes that "unlike western models of property, Māori relationship to the land is ontological, so that one's sovereignty is formed out of a genealogical relationship to the land, sea, and to nonhuman species."[13]

Anthropologist Elizabeth Povinelli's concept of "geontopower" can help frame current extractive practices of states and corporations, including the ontological implications of mining the seabed.[14] The concept of geontopower identifies the entanglement between nature and history that originated in the early nineteenth century, with the disciplinary distinction between geology and biology that had formed just prior to the emergence of Darwin's ideas. Geontopower is distinct from the concept of biopower, under which it nonetheless operates, because it is not only concerned with life and death as objects of governance, but with the governance of the distinction between life and nonlife itself. Beyond Foucault's characterization of the historical passage of sovereignty from the "right to kill and let live" to "the power of making live and letting die," for Povinelli, geontopower exists rather as: "live, let die, *and kill.*"[15]

In what Povinelli characterizes as Western "biontologies," the dichotomy of life and nonlife tends to aggregate other dichotomies such as biology and geology, biochemistry and geochemistry, ecosystem science and the weather. This opposition originates in the understanding in modern metaphysics that "being" presupposes "life." For some non-Western cosmologies, however, the distinction between life and nonlife is organized according to other concepts and relations, such as the animate and the inanimate, the lively and the inert. Western biontology is, by comparison, "the cramped space in which my Indigenous colleagues are forced to maneuver as they attempt to keep relevant their critical analytics and practices of existence … [It] is not a concept first and an application to my friends' worlds second, but a concept that emerges from what late liberal governance looks like from this cramped space."[16]

While the power to demarcate life and nonlife has greatly contributed to the expansion of colonial and settler-colonial regimes in the past, it may be coming further into the foreground now, as capitalism requires new spatial fixes. The vast area of the underwater mines that may result from deep sea mining could be an example. The neo-mercantilism that obliges a state to sponsor a corporation in order for the latter to obtain the International Seabed Authority's concession in international waters is another such potential example,[17] as well as the microscopic frontier of value extraction brought forth by the biotech lab.

Geontopower thus guarantees that a statement such as "'clearly, *x* humans are more important than *y* rocks' continues to be made, persuade, stop political discourse."[18] This is not because rocks should be saved over humans, but because, in enforcing the distinction between life (*x* humans) and nonlife (*y* rocks), geontopower denies *both* non-Western ontological distinctions between life and nonlife *and* relations of interdependency – those identified by Western biontology or not. Utilitarian political and corporate arguments such as "clearly, *x* humans are more important than *y* rocks or *z* fauna" appear not only at sites of indigenous struggles against extraction, although these have played an important part in anti–seabed mining resistance movements, such as the Māori struggle against seabed mining off the coast of New Zealand, or the struggle of the Alliance of Solwara Warriors in Papua New Guinea. As Sammler characterizes it, geontopower "applied to ocean spaces and resources, [enacts] divisions [that] are employed to categorically enclose land (*geos*) from sea (*hydros*), human (*anthropos*) from animal (*zoe*), and surface seas (*pelago*) from deep ocean (*abbyso*) and seafloor (*bathy*)."[19]

Thus geontological conflict is what is at stake when pro-mining agents lay claim to the seemingly barren abyssal plains where polymetallic nodules are deposited, as if the apparent emptiness were *terra nullius* and indicative of a lack of life.[20] And yet, despite being historically inaccessible to humans, any "barrenness" of this land has been produced by the effects of human intervention on the earth's surface. Consider the eighteenth- and nineteenth-century whaling practices that caused the extinction of different whale species and decreased the number of whale corpses that sink to the deep sea, creating important deep sea ecosystems from their remains. Or consider the accumulation of trash and pollution on the seabed in the last century. Only a narrow vision of ecosystems allows for descriptions of ferro-manganese nodules as "potatoes" fit for harvesting, which suggests that their removal would have little to no consequences. In fact, more sessile and mobile fauna live on or near these nodules than in nodule-free areas of the same region, suggesting that the nodules are crucial to these creatures' survival.[21] Despite the nodules' potato shape, the harvest metaphor obscures the fact that the rocks required millennia to form. Hydrothermal vents, for their part, were initially heralded as a "greener" site of extraction in comparison to seamounts and polymetallic deposits, due to the reduced total area they occupy worldwide, estimated at only 50 square kilometers in total.[22] Yet many scientists have come to the defense of the unique endemic species that each individual active vent harbors. In turn, mining companies now draw the line between active and inactive vents on the basis that the former sustain more life than the latter, a fact that remains questionable, given the impossibility of clearly separating the bacterial, chemical, and geological in sites such as these.

Biotech of Nonlife

Harvesting organic samples for biotechnological profit is potentially less invasive to undersea habitats and might generate revenue comparable to that of mining operation on the same site.[23] Therefore it might be tempting to oppose the mining industry to the less invasive approaches of the biotech industry as a way to compare different forms of ocean value extraction by pitting one industry against the other and pointing to the "lesser evil." The logic of a "lesser evil" is a pervasive greenwashing strategy used by the mining industry, which often compares the labor conditions of on-land mines and conflict minerals to the potentially less harmful offshore conditions of extraction atop a vessel performing extraction remotely.

While the "lesser evil" argument is perhaps useful in advocating for a deep sea mining moratorium, it perpetuates an all-too-neat set of equations: the assumption that economic comparisons between the market values of deep sea mining and deep sea biotech will foreclose one of them; and the implicit opposition between *bios* and *geos,* disregarding the porousness and interdependence of the two. Economic comparisons obfuscate the simple fact that there is no international mechanism in place, legal or otherwise, that allows one form of mining to happen at the expense of another. Because of this, in all likelihood, inaugurating an underwater mining industry would simply add to other on-land extraction sites perpetrated by other companies across the world. As is known from the frontlines of the climate crisis, capitalism, even more so at a global scale, is notoriously bad at shutting down profitable industries and divesting in futures that would require them to "dis-innovate, and dis-incubate" in favor of ecology.[24]

According to Stefan Helmreich's reading of philosopher Giorgio Agamben, horizontal gene transfer used in gene editing could be the basis of a new figure of *transfer* in the emerging molecular biopolitics of biotech. In his characterization of modern biopolitics, Agamben takes up the Aristotelian dichotomy between *bios* and *zoë* – biological "life-forms" and social "forms of life." In Agamben's reading, the terms operate according to a more complex distinction than that of human versus nonhuman, or nature versus culture. Rather, they differentiate between "the form or way of living proper to an individual or a group" (*bios*) and "the simple fact of living," also called bare life (*zoë*).[25] For Helmreich, transfer succeeds sex in Foucault's biopolitical structure, characterizing the micro-biopolitics that makes "elements associated with living things – genes, proteins, tissues – mobile, transferable across locations and organisms," and allowing "new biopolitical links – between persons and patents, polymorphisms and politics – [to] be forged."[26] The figure of transfer creates an "informatically inflected bare life that is increasingly agenealogical, molecular, and modular," whose growth and reproduction is increasingly available to be governed by *bios,* allowing for the market of patented genes to emerge.[27] In short, in order for a biotech lab to patent life from *bios* it must perform a new kind of separation of *bios* and *zoë,* one allowed by genetic technology but also by a legal system and commodity market ready to recognize this new form of extracting value from life and designate the patented gene fragment as nonlife.

The discussion as to whether biotech and mineral extraction will invalidate each other is ongoing. They may be neither opposed nor competitors. Consider, for example, a hypothetical future scenario in which a hydrothermal vent is bioprospected before it is mined for minerals. Bioprospecting may not require the continuous sourcing of a given gene, since once a first sample is extracted it can, in theory, be sequenced and replicated in a lab. Insofar as genetic prospection does not need to maintain life once it is synthesized, it could – again, hypothetically – be followed by other forms of extraction, leading to the deaths of particular animals and the extinction of the endogenous species harbored by a single hydrothermal vent. That is, the synthetic form of commoditized genes may not be incompatible with species extinction; it may exist in a space that is, under geontology, not beyond life and death, but rather between life and nonlife. That is, it is no longer just "the drama of life and death, but a form of death that begins and ends in Nonlife – namely the extinction of humans, biological life, and, as it is often put, the planet itself."[28] Furthermore, given that extremophile organisms often generate energy from the toxic mineral *geos* of their surrounding vent ecosystems, a tentative question arises: Could biotech's geontological frontier accomplish extracting "bare life" not from "a form of life" but from "a form of nonlife"? And could potential mining locations such as hydrothermal vents be such sites where geontopower manages to "live, let die, *and kill*"?

Deep Time in the Anthropocene

> The exploitation of the [industrial and pre-industrial] coalfields also uncovered large stratified fossil beds that helped spur the foundation of modern geologic chronology: the earth as a set of stratified levels of being and time. The concept of the Anthropocene is as much a product of the coalfields as an analysis of their formation insofar as the fossils within the coalfields helped produce and secure the modern discipline of geology and by contrast biology. But even as the coalfields helped create the modern disciplines of biology and geology, the carbon bomb it set off also slowly and then seemingly suddenly made these disciplinary distinctions differences of a different sort.[29]

Part of geontology's power may lie in its entanglement of the traditionally distinct disciplines of geology and biology – one which is pertinent if hydrothermal vents are proven to be at the origin of life on earth. In *Bursting the Limits of Time*, historian of geology Martin J. S. Rudwick narrates the early nineteenth-century emergence of the discipline of geology from the combined knowledges of science (minerology, physical geography, geognosy) and the late-mercantile or proto-industrial crafts required to mine coal, kaolin, and gypsum (to power steam engines, and to fabricate porcelain and plaster, respectively).[30] The integration of the three-dimensional visual rendering of maps used by the mining industry into scientific studies, as well as the geological specificities of the mining sites themselves, allowed for three-dimensional spatial representation (where drawings represented geological formations within a *x*, *y*, and *z* axis) of underground strata. Parallel to this, as a result of the French Revolution and the increasingly popular practice of chronology, the discipline of history became progressively conceptualized as a linear succession of events and crises. Geology was influenced by this fact and incorporated this newfound temporality. The earth began to be thought of as subject to contingent events and crises.

Rudwick characterizes this passage as the transition from the geo*theory* to the geo*history* of the earth: from a synchronic to a diachronic conception of natural time. In geotheory, rock masses were defined "in practice by their structural relations (lying below or above)," whereas geohistory came to explain these structural relations causally, by reading strata as markers of time.[31] While the sciences associated with geotheory sought description and classification over causality, geohistory attempted to define the laws of nature in a continuum between past, present, and future. In this framework the relation between life and nonlife, the biosphere and the geosphere, became an object of causal narration.

Such developments in the nineteenth century also inscribed the materiality of the sea with time. As Helmreich writes, "The sea shifted from a framework of biblical chronology to one apprehended through secular geology and evolution."[32] Darwin advanced the possibility that life might have remained unchanged in the deep sea, and that the study of its organisms produce specimens of "living fossils" from an evolutionary past. In this sense, writes Helmreich, "the Victorian imagination, in step with the then nascent scientific archaeology, came to associate the deep with the early history of the planet, as if going deeper meant going back in time."[33] The discovery of hydrothermal vents in 1977, and of the organisms located there that live in harmony with extremely high temperatures and toxic mineral plumes, prompted a resurgence of this Victorian belief. In Helmreich's words, the microbial life of hydrothermal vents "pushed not only at the metabolic limits of life but also at the very threshold of its beginning."[34]

Geohistory provided the framework in which calculating the age of the earth became a relevant scientific question. It expanded the previous understanding of time from the religious Christian context – which, before the eighteenth century, estimated a mere few thousand years from the beginning of the planet to the appearance of humans – to the contexts of geology and a temporal investigation of the earth's underground and underwater past.[35] While the historic moment of geology's appearance as a discipline may have provoked the search for an origin story, extractivism has since continuously reinscribed being and time within the knowledge of the ocean's depth. Take, for example, how oil extraction helped enshrine the geological-legal concept of the continental shelf, or the invention of seismic testing in the oil industry, a highly invasive form of sounding the underwater strata of the earth's crust to generate data on the geological composition of the seabed.

While defending the research and preservation of hydrothermal vents due to their pertinence in ascertaining how life might have begun on earth, we should also recognize that they are the site of an origin story particular to geohistory. They should therefore should be taken as a symbol of geohistory's own entanglement with the diachronic concept of time, one of the axes through which modern biontology is perpetuated. For this reason, hydrothermal vents could be taken as a particular type of monument, one that recognizes the historical and material contingency of *bios* and *zoë* plus *geos*, "natureculture" amidst the planetary extinction caused by late liberalism.[36] They should be recognized as being of both natural and cultural significance, since it is from the knowledge of geohistory that "we" in the Global North will attempt to fight climate change and halt the ongoing sixth mass extinction. However, "our" work cannot stop there. Such a history should also allow us to cautiously recognize that while the concept of the Anthropocene may blur the modern division between what constitutes nature and culture, it does nothing to destabilize the other modern concept of geohistory. On the contrary, the Anthropocene reinforces the centrality of geohistory within geontopower. It emerges in science's need to investigate deep time further – either the past, such as paleoclimatology, or the future, such as climate predictions regarding the human impact on the earth's future geological strata.

By going forward with mining and commercial forms of bioprospecting, we run the risk of fueling late liberalism's geontology and foreclosing other noncapitalist stories, be they origin stories or otherwise. All this is occurring at a moment when our biontology is coming undone as well. Povinelli describes the difficulty of distinguishing life from nonlife at the level of biochemistry and geochemistry; Helmreich explores how the phenomenon of lateral gene transfer has lead scientists to reconsider "genes, phylogeny, kinship and nature."[37] Finally, this recognition of a natural monument that is also a cultural construct of an origin story does not necessarily require Luddite science-bashing or a romantic nostalgia for a premodern time – sentiments which in themselves emerged as colonial byproducts. Nor should they operate under a cultural relativism that is oblivious to the history and the current mutations of the nature/culture divide inherited from modernity.

Many anti–deep sea mining organizations and communities are pushing for a moratorium on deep sea mining until 2030. They do so on the basis of the precautionary principle, which argues for caution and review where scientific knowledge is lacking. Yet, for all that is stated above, we should perhaps use the next decade to defend an extension of the precautionary principle that can encompass and negotiate forms of knowledge beyond Western biontology, just as we should question the UNCLOS's speciest category of "the Common heritage of Humankind," which does not consider heritage in terms of nonhuman life (and perhaps nonlife).[38]

The hope in concluding this way is that recognition of the natural-cultural contingency of these sites will open up a space that doesn't just prevent the exclusion of non-Western ontologies. This would be a space that acknowledges the extractivist construction of knowledge and power, and the drive to enact new capitalist sites of extraction by separating life and nonlife anew. Only then can the situatedness of Western biontologies' evolutionary geneology and origin stories become clearer and the porousness between life and nonlife, the animate and the inanimate, be acknowledged. Only then can the new "disciplinary combinations and alliances ... necessary under the pressure of Anthropogenic climate change" emerge.[39]

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All GIF animations generated from videos at inhabitants-tv.org.

On behalf of Inhabitants, I would like to thank Stefan Helmreich, Alexandre Monnin, and Katherine Sammler for their contributions and support on the web series *What is Deep Sea Mining?*, as well as the support of TBA21-Academy, CCA Singapore, and Visible Art Awards and Lafayette Anticipations. I would also like to thank Jose Rosales and Adam Israel for their feedback on the text. And last but not least, I am grateful for invaluable revisions and input from Margarida Mendes and Pedro Neves Marques over the last two years.

Inhabitants is Pedro Neves Marques, Margarida Mendes, and Mariana Silva. The group produces and streams short-form videos intended for free online distribution. Inhabitants was shortlisted for the 2017 Visible Award and was DAAD artist-in-residency at the Potsdamer Institut für Klimawandel in 2019. It has collaborated with or shown at institutions such as the New Museum (as part of the 2018 New Museum Triennial), Haus der Kulturen der Welt, Museu Coleção Berardo, Contour8, and DocLisbon International Film Festival.

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See https://www.isa.org.jm/frequently-asked-questions-faqs.

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In 2015, scholar Anna Zalik identified a configuration of BRIC-plus countries as the main strategic players: Brazil, Russia, China, UK, Netherlands, and Japan. Anna Zalik, "Trading on the Offshore: Territorialization and the Ocean Grab in the International Seabed," *Beyond Free Trade: Alternative Approaches to Trade, Politics and Power*, ed. Kate Ervine and Gavin Fridell (Palgrave Macmillan, 2015), 174. For year, private and state-led corporations have been scrambling to adapt on-land mining technology to the high pressure of underwater extraction. Of these, state-led companies in China and Japan are the most technologically advanced in the adaptation of mining equipment to the high pressure of the deep sea, along with the now bankrupt company Nautilus Minerals. Currently, Global Sea Mineral Resources (GSR), a unit of the Belgian group DEME, and Canada's DeepGreen are continuing tests and research while China is the best-positioned country, with a total of five contracts in international waters, to inaugurate deep sea mining on the high seas. "China Leads the Race to Exploit Deep Dea Minerals: UN Body," *Reuters,* October 23, 2019 https://www.reuters.com/article/us-mining-deepsea/china-leads-the-race-to-exploit-deep-sea-minerals-un-body-idUSKBN1X213T.

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See Ben Doherty, "Collapse of PNG Deep-Sea Mining Venture Sparks Calls for Moratorium," *Guardian,* September 15, 2019 https://www.theguardian.com/world/2019/sep/16/collapse-o f-png-deep-sea-mining-ventur e-sparks-calls-for-moratoriu m; and this press release from the Deep Sea Mining Campaign: "Nautilus Minerals: Still Lost at Sea with No Life Raft in Sight," November 25, 2019 http://www.deepseaminingoutofourdepth.org/nautilus-minerals-still-lost-at-sea-with-n o-life-raft-in-sight/.

4
Susan Reid, "Solwara 1 and the Sessile Ones," in *Blue Legalities: The Life & Laws of the Sea*, ed. Irus Braverman and Elizabeth R. Johnson (Duke University Press, 2020), 28. Chemosynthesis is what sustains organisms around hydrothermal vents – aphotic zones where sunlight does not penetrate. Like photosynthesis on land, it is the basis for these ecosystems. In biochemical terms, chemosynthesis is "the biological conversion of one or more carbon-containing molecules (usually carbon dioxide or methane) and nutrients into organic matter using the oxidation of inorganic compounds (e.g., hydrogen gas, hydrogen sulfide) or ferrous ions as a source of energy, rather than sunlight, as in photosynthesis." See https://en.wikipedia.org/wiki/Chemosynthesis.

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W. Martin, J. Baross, D. Kelley, et al., "Hydrothermal Vents and the Origin of Life," *Nat Rev Microbiol*, no. 6 (2008): 805–14 https://doi.org/10.1038/nrmicro1991.

6
The use of ribosomal RNA (rRNA) for genealogical classification was proposed by the geneticist Carl Woese, the same scientist who proposed archea as a separate domain to bacteria and eukaryota.

7
See https://www.sciencedirect.com/topics/neuroscience/horizontal-gene-transfer.

8
From William J. Broad's *The Universe Below*, cited in Stefan Helmreich, *Alien Ocean: Anthropological Voyages in Microbial Seas* (University of California Press, 2009), 100.

9
Helmreich, *Alien Ocean*, 100.

10
See https://en.wikipedia.org/wiki/Polymerase_chain_reaction.

11
See https://www.greenpeace.org/new-zealand/story/victory-for -the-oceans-and-all-of-new-zealand/.

12
See https://www.greenpeace.org/new-zealand/story/victory-for -the-oceans-and-all-of-new-zealand/.

13
Katherine G. Sammler, "Kauri and the Whale: Oceanic Matter and Meaning in New Zealand," in *Blue Legalities*, 64.

14
Elizabeth A. Povinelli, *Geontologies: A Requiem to Late Liberalism* (Duke University Press, 2016).

15
Povinelli, *Geontologies*, 8.

16
Povinelli, *Geontologies*, 6.

17
This point regarding mercantilism is made by Anna Zalik in "Trading on the Offshore."

18
Povinelli, *Geontologies*, 9.

19
Sammler, "Kauri and the Whale," 68.

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Although *terra nullius* has not been legally invoked in this context, the rhetorics reverberate in how the claim of a barren or empty landscape is never considered as such due to prior ecological devastation.

21
Because ferro-manganese nodules are potato-shaped minerals found in planes, the notions of "picking" and "harvesting" are often evoked. This obfuscates the millenia that took to form them, and the fact that they are the geological basis of an ecosystem, and that mining would not entail picking them but would in effect scrape a few meters of seafloor – for which the closest reference would be the environmentally disastrous bottom-trawling form of fishing. "Article 77(4) of the UNCLOS defines living natural resources as 'living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil.' If a marine creature's status is sedentary, UNCLOS deems it 'harvestable,' a euphemistic term likening commercial sedentary fisheries to gathering garden fruit. Legal scholars note that the inclusion of living resources, such as sedentary species, came late in the development of the continental shelf regime." Susan Reid, "Solwara 1 and the Sessile Ones," 36.

22
Van Dover et al., "Scientific Rationale and International Obligations for Protection of Active Hydrothermal Vent Ecosystems from Deep-sea Mining," *Marine Policy*, no. 90 (2018): 22.

23
"Bioprospecting, when undertaken using non-harvest approaches, is environmentally friendly, and there are already examples of marine genetic resources derived from vent discoveries. These include enzymes that function under extremes of temperature, chemistry, and pressure ('extremozymes' developed from very small samples of vent organisms) that have substantial impact on society, as well as commercial value. The Valley UltraThin™ enzyme, which increases the efficiency of ethanol production from cornstarch and is sourced from a deep-sea hydrothermal vent organism, posted annual sales value of $150M (USD). The market for enzyme products derived from all marine genetic resources has been valued at more than $50B per year. The value of biotechnology products derived from active vent ecosystems may compete well against the value of polymetallic sulfide ores, estimated at $1B annually for each mining operation. Exploration to discover and develop biofuel, nutraceutical, biomimetic, pharmaceutical, cosmetic, and other products from healthy, active vents could be an alternative, sustainable use of vent ecosystems." Van Dover et al., "Scientific Rationale and International Obligations," 23.

24
This point regarding the necessity of actively "foreclosing" futures has been made by philosopher Alexandre Monnin, among others. See https://www.lemonde.fr/blog/internetactu/2020/03/12/desinvestir-desinnover-desincube r-demain-la-derniere-start-u p/. This point is notorious when it comes to the energy industry: oil has not replaced coal, and renewables will likely not foreclose oil, coal, or nuclear energy. Instead, global energy consumption has risen consistently throughout the twentieth-century in what is known as the Jevon's paradox. The paradox posits that an economical use of energy may simply lead to increased, not reduced, energy consumption.

25
I am following Helmreich's reading of Agamben here. Helmreich, *Alien Ocean*, 101.

26
Helmreich, *Alien Ocean,* 101. For Povinelli it is the Desert, the Animist, and the Virus that succeed the Foucauldian figures of the masturbating child, the hysterical woman, the Malthusian couple, and the perverted adult.

27
Helmreich, *Alien Ocean,* 101.

28
Povinelli, *Geontologies*, 8–9. She adds: "In other words, it is increasingly clear that the anthropos remains an element in the set of life only insofar as Life can maintain its distinction from Death/Extinction and Nonlife."

29
Povinelli, *Geontologies,* 10.

30
Martin J. S. Rudwick, *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (University of Chicago Press, 2005). "Mineralogy" was the study of fossils, a science of specimens detached from significant field information beyond locality; "physical geography" did involve fieldwork, but it exclusively mapped rock formations on a two-dimensional plane at the soil's surface; and "geognosy" was the term for the site-specific maps that miners produced, which encompassed depth by describing the three-dimensional structure of rock masses.

31
Rudwick, *Bursting the Limits of Time*, 640.

32
Stefan Helmreich, script for Inhabitants' series *What is Deep Sea Mining?,* Episode 2: "Deep Frontiers." Available at inhabitants-tv.org http://inhabitants-tv.org/july2018_whatisdeepseamining_ep2.html.

33
Helmreich, script for Inhabitants' series *What is Deep Sea Mining?*

34
Helmreich, script for Inhabitants' series *What is Deep Sea Mining?*

35
"A proliferation of conjectural geotheories even offered ambitious accounts of how the earth must have changed in the past and would necessarily change in the future, based on reasoning from the known laws of nature. But attempts to reconstruct the detailed particularities of the earth's history from the concrete relics or traces of the deep past were few and far between." Rudwick, *Bursting the Limits of Time*, 644.

36
I am riffing here on artist Amy Balkin's artwork *Public Smog* (2004–present), which includes a proposal to protect the ozone layer as a UNESCO heritage site. According to the artist's website: "*Public Smog* is a park in the atmosphere that fluctuates in location and scale. The park is constructed through financial, legal, or political activities that open it for public use. Activities to create the park have included purchasing and retiring emission offsets in regulated emissions markets, making them inaccessible to polluting industries" http://tomorrowmorning.net/publicsmog.

37
Helmreich, *Alien Ocean,* 100.

38
"With a wink to corporate extractivists, UNCLOS provides the legal framework for DSM to thrive. Its conservation provisions gesture to environmental concerns but are notably weak and difficult to enforce. UNCLOS imports the precautionary principle supported by the Rio Declaration (1992) and the 1992 Convention on Biological Diversity (CDB), placing the burden of proof on corporations whose activities may pose a threat or cause irreversible harm. Such proof is difficult to verify in DSM's self-regulating environment: miners establish the environmental baselines against which their enterprises are measured; monitor their own progress against these baselines; and report on any changes. Operating several kilometers below the surface also makes it difficult for independent oversight or audit, and neither the International Seabed Authority (ISA) nor PNG or any small island nations have resources to deploy site-specific monitoring teams." Susan Reid, "Solwara 1 and the Sessile Ones," 27.

39
Povinelli, *Geontologies*, 10.