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Article

Geographical Defiance: Progressing from Underwater (Oceanic) Geography to Benthic Geography

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Abstract

Underground and underwater geographies have garnered much traction lately in environmental and human geography, given that resource exploitations often occur in these deep spaces. Whilst such scholarly work has contributed to knowledge, such as insight concerning dangerous labour and chemical pollution, current human geographers have rarely theorised the inextricable multiple seafloor entanglement. This lacuna exists partly because no concept can help express multiple humans, aquatic life, and seafloor relations. In response to this issue, bringing together island studies, queer ecology studies, marine science studies, and science and technologies studies (STS) in oceanic geography literature, this paper introduces benthic geography to remediate the entrenched binary logic separating the seafloor from other spaces and bodies. This paper contributes to current environmental and human geography by expanding the use of the benthic concept from predominantly marine science (i.e., benthic ecology) toward environmental geography. Ultimately, this article invites readers to reflect on our unexpected entanglement with the seafloor and other spaces through how the materiality of the seafloor oozes within and beyond multiple spatial boundaries. Therefore, this article also encourages scholars to create seabed knowledge that puts offshore extractive industries under public scrutiny.

Keywords: benthic geography; political ecology; queer; geopolitics

1. Introduction

Given the rhetoric of space and resource scarcity, extractive industries have moved further offshore and deeper beneath the sea (Sammler, 2020a). In response to this ocean industrialisation, the United Nations Convention on the Law of the Sea (UNCLOS) and the International Seabed Authority (ISA) have governed the ocean by creating bounded and stable categories (e.g., sea, subsoils, and seabed) (Havice and Zalik, 2018; Zalik, 2018; Lehman et al., 2021). While the spatial categories here enable the international treaty to divide, allocate, and control oceanic spaces as places and properties for global economic activities (e.g., deep-sea mining and undersea cables) (Peters, 2020), the spatial division has further promoted the seafloor-sea dichotomy. For example, using the UNCLOS, the ISA has labelled the seabed beyond national jurisdiction as an Area, a distinct space separated from the sea water column above it (Havice and Zalik, 2018). Through this separation, the ISA can specifically regulate, control and manage the use of the Area, disregarding the water column and the high seas above the seafloor. Beyond that, the binary logic here not only applies to the spatial categories but also affect those living on the seafloor. This has to do with the fact that the UNCLOS has mainly focused on governing the land-like qualities of the seafloor such as continental shelf and deep-sea minerals (Conde et al., 2022). Therefore, the fixated view on the geological characteristics of the seafloor excludes the existing marine life living on the seabed (Sammler and House-Peters, 2023). Therefore, as this binary logic imagines and constructs the seafloor as a flat, fixed, and lifeless space, this imagination here not only isolates the seafloor from other spaces and (non)-human bodies.

Instead, this separation also becomes a fundamental justification for allowing seabed mineral exploitations (Childs, 2018).

The sea-seabed binary above also comes about given the use of two dimensional, flat, and fixed map (Steinberg and Peters, 2015). This representation, of course, further removes the voluminous materiality and movement of the ocean. That is why, according to Sammler (2016), “ocean movements are better represented as relational flows from the viewpoint of a small volume of water moving through a larger fluid background. This is in stark contrast to the perspective of space as a container that the modeler can view from the outside and where motions are imagined at fixed positions in spaces” (23). Underpinning the work of Sammler, diverse environmental geography has further interrogated how the relation between the depth of the sea, the seafloor, aquatic life, and humans not only contests the sea and seafloor binary but also enable or constrain particular territory making of oceans for particular offshore extractive projects (see, for example: Childs, 2019; Barry and Gambino, 2020; Squire, 2021; Saputra and Sammler, 2024). While these social scholarships have disrupted the separation between the seafloor and water column through thinking with oceanic materialities, current social science literature do not have a concept to express multiple seafloor entanglement. This conceptual gap exists as there is no terminology, which capture the combination of the seafloor with other spaces and bodies.

To address this lacuna, this paper introduces benthic geography. Benthic geography here is contextualised in the current oceanic geography (Anderson et al., 2022) and is placed at the intersection of marine science, island studies, queer ecology studies, and science and technology studies. The word benthic alone originates from the Ancient Greek *βένθος*, which refers to the depth of the sea (Conser and Shanks, 2019). Whilst the depth of the sea (hereafter benthic space) is often measured numerically through technological and scientific instruments (Sammler, 2020b), reflecting on benthic space here also complicates our understanding of how deep the ocean or the sea is. This has to do with the fact that one cannot know when and where the sea begins and ends (Sammler, 2016; Pauwelussen, 2017; Lehman, 2020) since the sea evaporates, condenses, and precipitates as part of the hydrological cycle (Steinberg and Peters, 2015; Sebuliba, 2024) and even exists within humans’ blood, tears, and bodies (Neimanis, 2012; Levi and Peters, 2024). Therefore, benthic space captures messy sea entanglement as the sea permeates and occupies multiple spaces and bodies. Understanding this relational account, benthic ecology has used benthic concept to study benthic environment more than environmental geography. Despite that, benthic ecology mainly focuses on seabed-dwelling organisms and their surroundings (e.g., the seafloor and water column). Indeed, benthic ecology has contributed to creating benthic indicators to assess environmental degradations on this deep space (Dauvin et al., 2010; EPA, 2022). However, the benthic knowledge production often excludes particular human interventions by separating benthic ecologists from observed benthic habitats. Removing human interventions from the benthic habitats here replicates the belief of nature-culture dichotomy (Helmreich, 2011). As (Nurmi, 2020) argues the shared ideology of ecology in marine science indicates “nature” should be devoid of humans to produce neutral and objective knowledge. Thus, the objective notion here often cannot capture social and political context within which benthic knowledge is created and operates.

Expanding the scope of benthic concept from benthic ecology toward environmental geography, benthic geography focuses on locating and examining multiple benthic phenomena. Benthic phenomena broadly mean a series of phenomena that occupy benthic space and benthic space also occupy these phenomena. Speaking of phenomena, Barad (2007) argues that phenomena mean “the objects and measuring agencies emerge from rather than precede” (128). In this way, benthic phenomena remediate the dichotomy between observers (humans) and observed objects (e.g., seafloor, benthic habitats, and sea) as both categories emerge together rather than precede one another. By attending to benthic phenomena, this paper argues that benthic geography challenges the separation logic, often put to use to justify seafloor exploitations. Additionally, through benthic phenomena, the seafloor oozes within multiple spaces and bodies. In this way, if the seabed is not external to human bodies, one begins to realise that we are the seabed. Thus, benthic geography

encourages more caring attitude and public scrutiny on rising seabed industrialisation as what happens to the seafloor also happens to human bodies. Concurrently, as social science focuses on human interventions, social scholars can study benthic geography to capture and locate social and political context within which the seafloor is constructed and governed through particular benthic phenomena. Hence, this contribution democratises the benthic knowledge production from the territory of benthic ecology.

While I have explained briefly what benthic phenomena mean above, I do not elaborate what emergent measuring agencies and objects mean. For that reason, section 1.2 will discuss how benthic phenomena work by also expanding and explaining the role of emergent measuring agencies and objects. This section also showcases how benthic phenomena exist everywhere from the creation of the seabed and the sea through the UNCLOS to multiple long-standing and emerging seabed uses. As benthic phenomena are emergent everywhere, to render the discussion feasible, this paper will focus on analysing benthic phenomena existing in marine science, island studies, science and technology studies, and queer ecology studies. The analysis of benthic phenomena here are organized in following sections. Section 1.3 provides the inextricable relation between deep-seabed observers in Alfred Wegener Institute (AWI), Germany and benthic habitats in deep sea observation. This section showcases the inextricable relation between the way of knowing the seafloor and what the seafloor means through the perspective of marine science. Meanwhile, moving from marine science, section 1.4 focuses on how island studies have explained the seafloor, island, and sea relations through the volcanic seamount eruption and sea level rise. This section offers an example of benthic phenomenon through the evolving relation between the islands, the sea, and the seafloor. Concurrently, as the seafloor and land relations also exist given existing infrastructure, section 1.5 emphasizes how science and technology studies (STS) have also challenged the binary logic through how undersea infrastructure connects the terrestrial land and humans with the seafloor. Underpinning previous relational accounts, section 1.6 presents how queer ecology studies revisit the seafloor and human relations through thinking with the biophysical element of the seafloor and human bodies. The various adjacent fields of studies here not only provide the concrete examples of benthic phenomena, contesting the binary logic inserted within the dominant imaginary and knowledge of the seafloor. Finally, the last section reflects on why knowing multiple human-seafloor entanglement through a series of benthic phenomena matter to care and encourage current public scrutiny on the use and governance of the seafloor.

2. Benthic Phenomena Under Scrutiny

Benthic phenomena rupture the dichotomy between measuring agencies and observed objects. Through benthic phenomena, one may know that how humans come to know the seafloor and what the seafloor means are intertwined rather than precede one another. Hence, the seafloor can come to exist given and through benthic phenomena. Without particular benthic phenomena whereby, observers observe and measure the seafloor, the seafloor cannot emerge by itself. For example, the seafloor does not pre-exist the UNCLOS. Instead, the UNCLOS creates “the seafloor, seabed, and ocean floor” through its mapping metrics and dividing up ocean space for properties. Beyond the geopolitical construction of the seafloor through international treaty, the seafloor also emerges through other practices of measuring the seafloor. While biologists measure the seafloor through the growth of the coral reefs, undersea cable corporations focus on measuring the substrate of the seafloor (e.g., muddy and rocky seafloor) to determine the armours of the undersea cables. Therefore, benthic geography can demonstrate that benthic knowledge production is not neutral as the observers also define what the seafloor means through their particular interests in the seafloor and benthic habitats.

As the way of knowing the seafloor comes to exist through multiple human interventions and activities or infrastructure, benthic phenomena happen everywhere from legal, scientific, technology, business, and everyday life. For example, while the UNCLOS has provided geopolitical stability in accessing the sea and seafloor, human interventions have long existed beyond such geopolitical interventions. The transatlantic telegraph cable was laid in the 1850s, and since then, transoceanic

cables have proliferated, spanning much of the globe yet largely invisible (Starosielski, 2015). The seabed's invisibility is crucial for the undersea infrastructure, given that it sets up conditions under which the infrastructure is hidden and safe from public disturbances (Barry, 2013; Childs, 2019; Barry and Gambino, 2020). Beyond these established infrastructures, emerging seabed uses have also sprung up worldwide. In Florida, Neptune Memorial Reef company has created undersea cemeteries, allowing one's ashes to be formed into substrates for coral reef growth, purporting ecosystem restoration (Nmreef, 2022). Furthermore, the discovery of wine from the Titanic shipwreck has catalysed the undersea wine aging industry in France, America, and Italy, where the cold, dark properties of the deep are put to use as a surrogate cellar (Puckette, 2020; Pomranz, 2021; Kassam, 2021; Thompson, 2021). As a new mining frontier, Japan has already begun extracting marine nodules from over 2000 meters below the sea, preceding proposed deep-sea mining projects in Papua New Guinea (Carver et al., 2020) Tonga, Cook Islands, Nauru, and Kiribati and, more broadly, across the Pacific Basin (Sammler, 2016). The long-established and emerging utilisation of the seabed indicate a series of benthic phenomena as there exists the interplay between measuring agencies (human observers) and observed objects (e.g., the seafloor and benthic habitats) interacting with the seafloor. Thus, these benthic phenomena also shape the material and immaterial dimension of the seafloor.

Concurrently, even though measuring agencies above refer to human observers, measuring agencies in benthic phenomena can also have a broad meaning. This argument echoes the work of Knappett and Malafouris (2008), arguing the term agency, "the capacity to act" has become the sole property of humans, especially given that such formulation of agency solely considers human consciousness and intention. However, as Poveneli (2011), Yusoff (2013) and Nowak and Roynesdal (2022), among others, argue non-humans (e.g., rocks, animals, viruses, and plants) have agency as these nonhumans inspire, enable, constrain, or imbricate human agencies. Thus, understanding such human and non-agencies, one should also understand that an object can also become a measuring agency. Knowing that an object can also become a measuring agency means that an object in benthic phenomena is also actively shaping the meaning-making of the seafloor. Thus, both human observers and objects also construct what the seafloor means. This knowledge not only disrupts the human and seafloor dichotomy but also challenges humans-centric definition of the seafloor. This insight is crucial because recognizing the agency of non-humans on defining the seafloor can contest dominant knowledge of the seafloor, which often removes the existence of particular non-humans. Meanwhile, as benthic phenomena happen everywhere, in what follows, I will provide examples of benthic phenomena from diverse social and natural science studies and multiple seafloor uses. Given that the seafloor exists in everyday life through particular benthic phenomena, one start to understand that our lives depend on the seafloor. Thus, understanding such benthic phenomena can encourage caring attitude and public scrutiny to particular human interventions on the seafloor.

3. Benthic Phenomena Through Marine Science

Given the interest of the marine nodules (potatoes like rocks) containing nickels and rare earth elements, environmental impact assessment on deep-seabed mining has been underway. As developing the environmental impact assessment guidelines requires knowledge concerning the biodiversity of deep-seabed, marine scientists record these diverse lives beneath the sea. For example, using deep-sea camera monitoring devices, deep-sea biologists from Alfred Wegener Institute (AWI), Germany, Purser and Boetius (2023) have showcased how marine nodules matter for the survival of deep-sea (Casper) octopus populations as these potatoes-like rocks become the octopus's spawning and sheltering ground. The relationship between deep-sea octopuses and marine nodules here has indicated how marine nodules are not mere rocks or non-living natural resources on the bottom of the sea but also a habitat for these benthic organisms. Meanwhile, since the benthic habitat is crucial for developing environmental impact assessment for deep sea mining, Purser continues his work on revealing unique benthic life forms in the deep. As Buehler (2021) documented in Purser's work:

"At one site under the Flichner ice shelf – ice floating in the Weddell Sea – one of Purser's teammates noticed something. Circular nests kept showing up on camera. They belonged

to Jonah's icefish (*Neopagetopsis iouanah*). These fish are only found in the Southern Ocean and Antarctic waters. Traits they adapted to survive the extreme cold included the development of clear blood full of antifreeze compounds" (Buehler, 2021: 1).

The existence of icefish here indicates that separating the geological aspect of the seafloor from its biological aspect is impossible. This, of course, challenges the binary logic of the seafloor inserted by the UNCLOS and ISA as the icefish and the seafloor are continuously interacting with one another. Additionally, as the ice fish can also swim above the seafloor and dig the seafloor, the ice fish also becomes a reminder that the seafloor has its volume and depth. This deep-sea research indicates benthic phenomena. This has to do with the fact that our understanding of the nest of the ice fish cannot emerge without the effort of Pulser in documenting the benthic species through his underwater (deep-sea) camera. Therefore, Pulser and his underwater camera are the measuring agencies while the ice fish nest is the object. Altogether, the icy fish, Pulser, and his underwater camera are benthic phenomena. These phenomena allow us to contest embedded divisions between humans, benthic habitats, and the seafloor. More importantly, these benthic phenomena also disrupt the idea that the seafloor is a mere flat, static, and lifeless space.

4. Benthic Phenomena Through Island Studies

In island studies scholarship, island, seabed, and sea are not separated spatial categories. Instead, they are connected categories. The idea of island, seabed, and sea relation here does not come about from a mere metaphor. Diverse island studies scholars use the material and immaterial aspect of the islands to contest an entrenched binary between islands and sea. For example, Hau'Ofa (2008) observed and explained how the birth of islands from the sea rupture island and sea binary, put to use to maintain and structure the confinement of Pacific Islands:

"[N]amely Europeans introduced the view of "islands in a far sea". Later on, continental men—Europeans and Americans—drew imaginary lines across the sea, making the colonial boundaries that confined ocean peoples to tiny spaces for the first time. These boundaries today define the island states and territories of the Pacific. If this very narrow, deterministic perspective [separating ocean and islands] is not questioned and checked, it could contribute importantly to an eventual consignment of groups of human beings to a perpetual state of wardship wherein they and their surrounding lands and seas would be at the mercy of the manipulators of the global economy and "world order" of one kind and another" (Hau'Ofa, 2008: 32).

The work of Houfa here has contributed to current work on island studies and inspired many activists to reflect on how oceanic phenomena provide theories for seeing human problems differently. For example, DeLoughrey (2017) turned to:

"[K]amau Brathaité's theory of "tidalectics" [inspired by the tidal wave, recurring waves that create shallow water given the moon and earth gravitational pool]", a methodological tool that foregrounds how a dynamic model of geography can elucidate island history and cultural production, providing the framework for exploring the complex and shifting entanglement between sea and land, diaspora and indigeneity, and routes and roots" (DeLoughrey, 2007: 17).

The island studies above have utilized oceanic phenomena to formulate the theory of sea and island relations as a resistance to colonial binary perspectives. The epistemology of ocean and island relations have also been used to contest the recreation of difference such as diaspora and indigeneity, which often uses to normalize social violence by humanizing one group and dehumanizing the other groups. Thus, even though the work is about island and sea relation, the theory is also used for political and social problems.

In the same vein, other island studies also indicate the material entanglement between the sea, seabed, and islands through the phenomenon of the birth of islands and sea level rise. For instance, Hawkin shows how the islands have emerged from the undersea volcanic activity. In this way, what

has long been the seabed has become an island especially given that the eruption of the undersea mountain creates an island. Meanwhile, Sammler focuses on the sea level rise has also shown what has long been islands has become the seabed given the sea surface that covers the area of land. Such phenomena that are inter-exchanging the definition of the sea, the seabed, and islands imply the seabed is not static. Instead, the spatial categories are interchanging, connecting, and evolving over time. This is also not to mention, for instance, that the mount Everest in itself was also once the seafloor especially due to the marine fossils that are found on the seabed. Of course, such phenomena complicate the stable definition of the seabed. These phenomena can also be called benthic phenomena especially because the measuring agencies such as the sea, the seabed, and the islands shape the meaning-making of the seabed, largely depending on the existence and the awareness of benthic space.

5. Benthic Phenomena Through Infrastructure and Nature Relations in STS

As the hierarchical dichotomy between the seabed, sea, island exists given the nature and culture binary, science and technology studies (STS) also showcases how the spatial categories are connected through particular infrastructure that span across multiple spatial boundaries. For example, exploring the undersea infrastructure, Starosielski (2015) challenges the dominant idea of the wireless world in the current digital world by demonstrating that 90% of the internet data transition can take place due to the undersea cables. This indicates that the world is a wired world. The existing fiber optic cables on the seafloor connects deep ocean with islands and our everyday life. The use of the seafloor as an important space for undersea infrastructure demonstrates the argumentation of Carse (2012) on how nature has also become part of the infrastructure. In other words, the dichotomy between nature, which in this case the seafloor, and infrastructure become blurred as nature also play a vital role in supporting and constraining the operation of the undersea infrastructure (Barry and Gambino, 2020). Understanding the tangled relations between infrastructure and nature here reminds us that conserving nature like the seafloor and benthic habitats mean supporting our infrastructure.

Beyond the long-standing seabed uses such as undersea pipelines and submarine cables, the relationship between nature and culture also exists on the seabed through emerging seabed uses. For example, In Florida, Neptune Memorial Reef company has created undersea cemeteries, allowing one's ashes to be formed into substrates for coral reef growth, purporting ecosystem restoration (Nmreef, 2022). Furthermore, the discovery of wine from the Titanic shipwreck has catalyzed the undersea wine aging industry in France, America, and Italy, where the cold, dark properties of the deep are put to use as a surrogate cellar (Puckette, 2020; Pomranz, 2021; Kassam, 2021; Thompson, 2021). As a new mining frontier, Japan has already begun extracting marine nodules from over 2000 meters below the sea, preceding proposed deep-sea mining projects in Papua New Guinea (Carver et al., 2020) Tonga, Cook Islands, Nauru, and Kiribati and, more broadly, across the Pacific Basin (Sammler, 2016). In this way, while the long-established and emerging utilisation of the seabed here indicates the habitat and inhabitants of the seafloor are not devoid of human interventions and activities, the current marine science (i.e., benthic ecology) does not necessarily expand the reality of the seafloor beyond marine animals, plants, and their habitats. That is why the seabed is not devoid of human culture. Instead, the use of the seabed mirrors human cultures rather than the nature of the seabed. Therefore, the relationship between infrastructure and nature on the seabed indicate benthic phenomena, which deconstructs the seabed as a lifeless space free from human interventions.

6. Bio-Physical Element and Human Bodies Relations in Queer Ecology Studies

While contesting a nature and culture binary seems a trivial issue, in actuality, such logic has structured and maintained certain racial, religious, sexual, and gender minority violence and discrimination. Hayward (2010) argued how the essentialism of "natural" and "unnatural" has become the justification for the discrimination and violence in non-heterosexual and non-conforming

gender communities. For that reason, queer ecologies scholars such as Mortimer-Sandilands, Erickson, and Cohen (2010), among others, have reconceptualized the concept of *ecologies* to emphasize nature and culture relations and reject nature and culture dichotomy. In fact, Mortimer-Sandilands & Erickson (2010) argue ecology is by definition 'queer' because ecology deviates from essentialism, separating nature and culture and other binary (geo/bio) divides.

Meanwhile, parallel with island and critical oceanic material studies above, queer ecologies have also reflected on oceanic phenomena to contest and disrupt certain essentialist political assumptions on human reproduction and the environment. For instance, queer ecologies scholars have informed their work through the non-heterosexual reproduction of marine animals such as cup corals, starfish, grouper fish and other marine animals to challenge the essential separation between natural and unnatural sexual reproduction, criminalizing non-confirming sexual and gender identities (Chisholm, 2010; Hayward, 2010; Garvey, 2012; Hayward, 2008a, 2008b; Mortimer-Sandilands & Erickson, 2010; Wilson, 2002; Wissenburg, 2012). Additionally, queer ecologies scholars have used oceanic phenomena as a form of resistance toward essentialism that enables environmental issues. The expansion of the queer ecologies work beyond sexual violence problems toward environmental issues is possible due to the work of Hunt and Holmes (2015) redefining what queer means:

"[W]hile queer is often used as an identity or umbrella term for non-normative sexual and gender identities [Lesbian, Gay, Bisexual, Trans, and Queer or LGBTQ+], it emerged as a critique of the essentialist constructs and identity politics. As a verb, queer is a deconstructive practice focused on challenging normative knowledge, identities, behaviors, and spaces, thereby unsettling power relations and taken-for-granted assumptions. Queerness is then less about a way of being and more about doing and offers the potential for radical critique" (Hunt and Holmes, 2015: 56).

Given the reconceptualization of queer as a deconstructive practice to unsettle power relations and taken-for-granted assumptions, diverse scholars have contributed to queering certain dominant essentialist political views of nature, catalyzing environmental issues. This argument also echoes the work of thinking with the bodies of water beyond the embodiment (Neimanis, 2017). As Neimanis (2017) argue:

"[G]iven the various interconnected and anthropogenically exacerbated water crises that our planet currently faces – from drought and freshwater shortage to wild weather, floods, and chronic contamination – this meaningful mattering of our bodies is also an urgent question of worldly survival. I reimagine embodiment from the perspective of our bodies' wet constitution as inseparable from these pressing ecological questions. [That is because], we are bodies of water. As such, we are not, on the one hand, embodied (with all of the cultural and metaphysical investments of this concept) while, on the other hand, primarily comprising water (with all of the attendant biological, chemical, and ecological implications" (Neimanis, 2021: 1).

The work of Neimanis above not only expands the concept of embodiment as introduced by feminist scholars (Dixon, 2016; Sharp, 2022) but also indicates how the sea physically connects our bodies through the hydrological cycle of the sea from evaporation, precipitation, and rain. Here Neimanis *queers* the notion of distance inherent between the ocean and humans. Instead, through such hydrological relation, Neimanis wants to show how any contamination and pollution of the ocean also affects human bodies. Beyond that, attending to benthic phenomena also complicate what the seafloor means. For instance, the hydrothermal vent of the seafloor produces organic and inorganic compound, a building block of human amino acids and genes. As Purvis et al. (2024), benthic scientists explains:

"[T]he mixing zone between bicarbonate and CO₂-enriched seawater...and the hydrogen-rich fluids from hydrothermal vents is one compelling potential environment of the origin of life. Organic compounds in modern AHV [alkaline hydrothermal vent] fluids of the Lost City hydrothermal vent [for instance] are dominated by C₉-C₁₄ aliphatic hydrocarbons, C₆-

C₁₆ aromatic compounds and C₈-C₁₈ carboxylic acids, a fraction of which may have produced abiotically" (Purvis et al., 2024: 2).

The organic and inorganic compound of the hydrothermal vent here can become a measuring agency that challenges the dichotomy and hierarchy between humans and the seafloor. Primarily, Since the mixing zone between organic and inorganic compounds is the building block of human amino acids, these organic and inorganic materials showcase how the seabed also exists within our bodies. However, beyond this cellular relation, these organic and inorganic materials matter for the benthic ecosystem and the planetary environment in which we are living. For instance, Tunnicliffe et al. (2024), biologists, have showcased how organic and inorganic materials are vital for the production of phytoplankton. That is because phytoplankton use the organic and inorganic materials produced as their nutrients for biomass growth. Therefore, since phytoplankton produces 70% of the oxygen we breathe in terrestrial land (Sekerici & Petrovskii, 2015), the hydrothermal vent ecosystem determines human quality of life and survival.

6. Conclusions

Bringing together marine science, islands, queer ecologies, and science and technologies studies within oceanic geography literature, this paper conceptualizes benthic phenomena. The examination and conceptualization of the benthic phenomena expands current work in undersea and oceanic geography literature to enable one understand benthic geography. However, the question of how to operationalize the benthic phenomena in research and activism still remains unresolved in this paper. For instance, how can one apply such benthic phenomena in political geography and policy intervention concerning the utilization of the seabed? In what way do benthic phenomena enable political resistance toward extractive seabed activities? Or in what way does it help us dispel the dominant geopolitical construct of the seabed that systemically and structurally maintains and sustains the seabed exploitation? Perhaps one of the most important questions is why benthic phenomena here make us care about the seabed and why caring about the seabed matters in the first place. The series of questions here requires a critical reflection on why one should care for the seabed.

Since critical reflection is, indeed, never an individual activity, as argued by Barad (2007), given that reflection often requires something and someone to reflect on. This means one should rethink various benthic phenomena permeating through our everyday lives. For example, we must reflect on why it matters to understand that the organic and inorganic materials of the seabed are the origin of our lives or that we share our genes with the seabed. Why should we care about knowing that the oxygen we breathe daily depends on healthy benthic ecosystems? Or what is the point of understanding that the benthic ecosystem absorbs the carbon emissions we produce? What do all these various benthic phenomena mean to us (humans)? Indeed, the questions here challenge us to think deeply about our relation to the seabed. And perhaps, some of us might not have the answer as this reflection can create a forever disorientation. However, one thing is for sure, from this reflection, we find the seabed in ourselves, from the carbon and hydrogen chain forming amino acids and genes in our bodies, the air we breathe in and out, the temperature we feel, and beyond. *We are the seabed.* Such a relation is crucial because we may realize that the seabed is intimate and internal to our bodies, interacting with ourselves and sustaining our lives. That is why as we are not exterior to the seabed and the seabed is not external to us, such onto-epistemology of the seabed provides the ethical-political positionality to care about the ongoing, long-standing, and emerging seabed utilizations. That is because what happens to the seabed can also happen to our bodies. This intimate relation hopefully creates global resistance toward seabed exploitation and extraction. After all, if geopolitics is about conflict and war (Dodds, 2007; Elden, 2013), reflecting on benthic phenomena could help us question what war and conflict are worth fighting for humankind. Perhaps the worthy war and conflict we can fight for is to resist the dominant geopolitical construct of space and place that sustains and structures certain social and environmental violence often invisible from our eyes, including seabed exploitation.

While such reflection matters and offers ethical political positionality to care for the seabed, the most important thing is how reflecting on benthic phenomena creates tangible action in research and activism. Indeed, both research and activism here should ideally be queer, as the practice of research and activism often require information and knowledge to create political action. Given such concern on how to operate and translate benthic phenomena in practice, I argue that investigating benthic phenomena provides some tangible steps to understand how certain geopolitical construct of the seabed structures and maintain seabed exploitation. For example, since benthic phenomena remind us of how the UNCLOS has orientated our views on seeing what the seabed is through their binary, static, and fixed logic, this understanding enables us to assume that diverse scales of governance follow this geopolitical orientation (direction). That is because the international treaty has become the top-down hierarchical geopolitical order for its coastal state members and the ocean in general. This means the geopolitical construct of the seabed the treaty prescribed can also be used as a way of governing, managing, and using the seabed. For that reason, one can then trace in what way, where, when, and how policy interventions and practice have applied the binary, static, and fixed logic of the seabed prescribed by the UNCLOS and the Law of the Seabed in managing, governing, and using the seabed. This means one can investigate how such binary, static, and fixed logic propagates ecological violence and in what way certain benthic phenomena can assist and resist seabed exploitation. Therefore, investigating benthic phenomena allows one to understand how certain material practices and policy interventions of the seabed, such as deep-sea mining, undersea cables, submarine pipelines, and beyond, have been adopting such static, fixed, and binary logic in their practices and how certain benthic phenomena can enable us to contest and deconstruct this logic through how the seafloor use create interaction and relation with the seafloor.

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